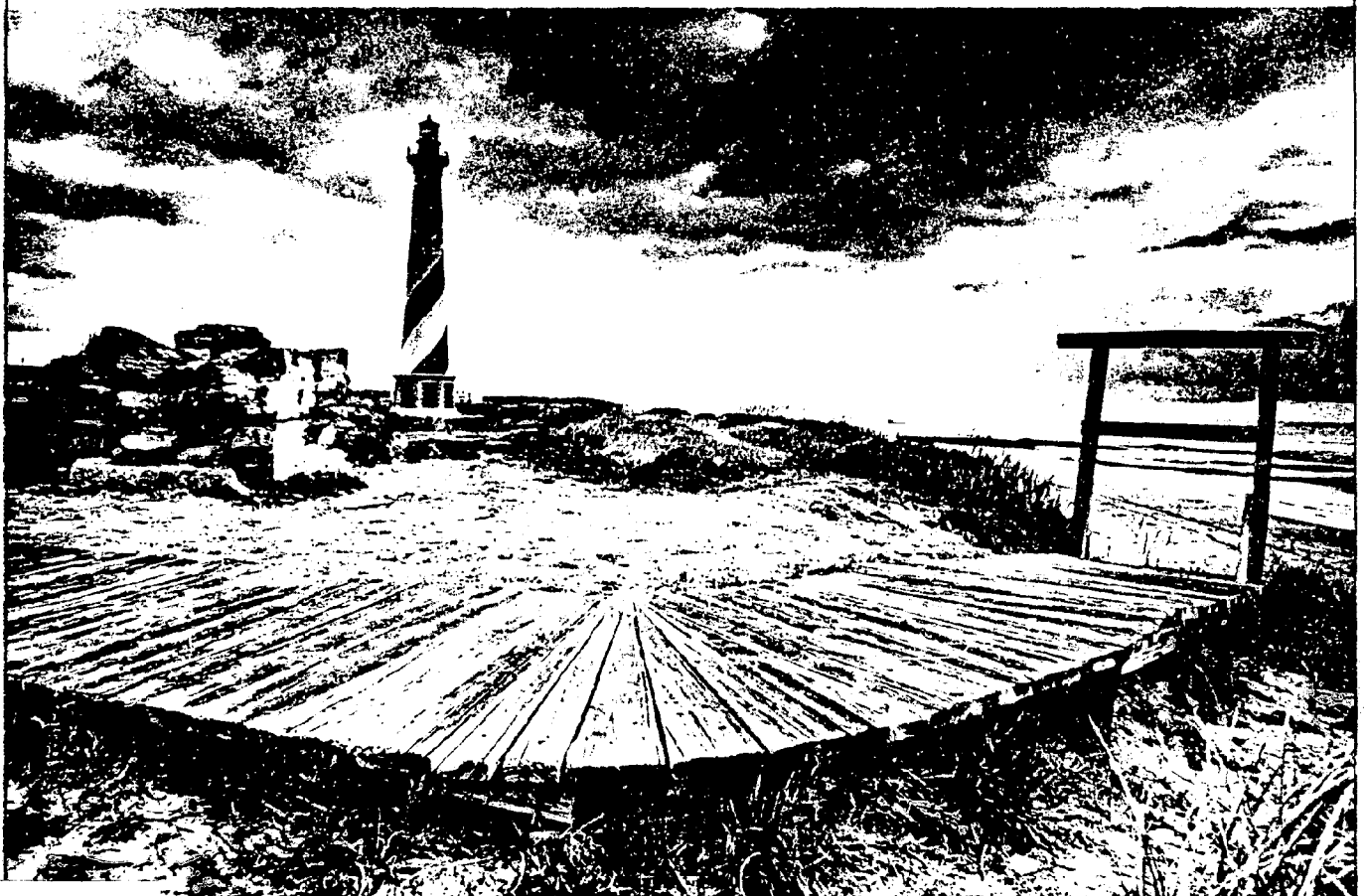


Before the Storm in Beaufort County:
Avoiding Harm's Way



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1984

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BEFORE THE STORM IN BEAUFORT COUNTY, NORTH CAROLINA

Avoiding Harms Way

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BEFORE THE STORM IN BEAUFORT COUNTY, NORTH CAROLINA
Avoiding Harms Way

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I. INTRODUCTION

A. Why do Hurricane Planning?

There are three major reasons to plan to reduce hurricane damage:

To save the lives of family, friends and neighbors.

To save investments in buildings and equipment.

To save irreplaceable natural resources.

Those of us in Beaufort County who remember the storm of yesteryear don't require too much convincing that some forethought would be worth the trouble such planning requires.

- . The storm of 1913 flooded Washington to a height of 10 feet, hence today's minimum height of the ground floor in the flood hazard areas on Washington (Aurora has a minimum of 9 feet and Belhaven of 7 feet. All other areas of the county except Bath and Chocowinity are assigned the 10 feet designation under the emergency phase of the FEMA program.)
- . Similar storms of 1933 and 1938 brought significant catastrophies. (On September 15, and 16, 1933, stormwater reached 7.5 feet.)
- . In 1954, Hurricane Hazel brought Washington to a level of 7 feet.
- . The County was hit three times in 1955 by Connie (6.4 feet), Diane (7.7 feet), and Ione (7.8 feet).

. Donna struck in 1960 flooding to 6.5 feet.

. In 1972, Hurricane Ginger brought Washington's waters to a 6.2 feet level.

Here it is 1984, nearly 30 years after the blasts of 1955, one generation removed from the reality of having to suffer the costs of such losses and of rebuilding at higher construction prices. One generation is long enough for unwary developers and homeowners alike to invest \$20,000 to \$30,000 in a lot which no responsible person would have even offered for sale, much less bought, in 1957.

May we say at the outset that this plan does not intend to stop development on such (usually waterfront) lots, but it does intend to lay out policies which will:

1. Inform developers and homeowners alike of the risks (in dollar terms) of placing investments in the hurricane hazard area.
2. Examine policies for directing development into areas of less risk (as a first priority) and for requiring better construction quality (stormworthiness) for construction in the risk area, before and after the storm.
3. Provide additional information on the evacuability of the county's major evacuation routes and updates for the DEM Hurricane Evacuation Plan.

B. Contents of this Document

The preceding topical outline details the contents of this plan. In overview, Part II presents the data base and findings upon which alternative policies are suggested and then presents policy choices of the commissioners.

Part A presents the Storm Hazard Mitigation planning process which is directed at reducing risks of hurricane damage. It answers questions of "Where is harm's way?" in the County, and "What is in harm's way?". "Are we over-exposing ourselves and our citizens to risks of storm damage?" "What are ways in which we can reduce that exposure to safer levels?"

Part B presents the Post Disaster Reconstruction planning process which is directed toward replacement of development in a manner which prevents the mistakes of the past and can help protect investment for longer periods in the future. It answers questions like, "Since we know where harm's way is, what can safely be built there?". "How strongly should buildings there be built?" "Does it make sense for risk areas to develop at high densities, medium, or low densities?" "What level is best, where?" This section answers these questions in terms of policy statements for implementation by the commissioners.

Part C presents information collected in the update of the county's evacuation plan. Some of this information is presented here, while much of the update of the plan itself is found in Annex O of the County's Disaster Relief Plan, of the Office of the Coordinator of Emergency Management.

Part D documents effort of coordination made during the preparation of the document. These contacts may be important in keeping the coordination tight among agencies and in updating this plan over time, since this document is to become part of the Beaufort County Land Use Plan (by reference).

II. POLICY DEVELOPMENT

A. Storm Hazard Mitigation

1. The Planning Process

a. Generally

Planning to reduce the risk of hurricane damage before the storm is a logical sequence of steps diagrammed in Exhibit A. This process, beginning with data collection and mapping, and ending in implementation steps, ensures that policy development is based upon thorough study.

b. Specifically in Beaufort County

Planning to reduce the risk of hurricane damage in Beaufort County follows Exhibit A very closely. It is complimented by intense worksessions with experienced veterans in the field of emergency management, and gutsy policy discussions with the County Commissioners.

This process began with an 8 day field investigation of the location of hurricane hazard areas.

2. Mapping Hazard Areas

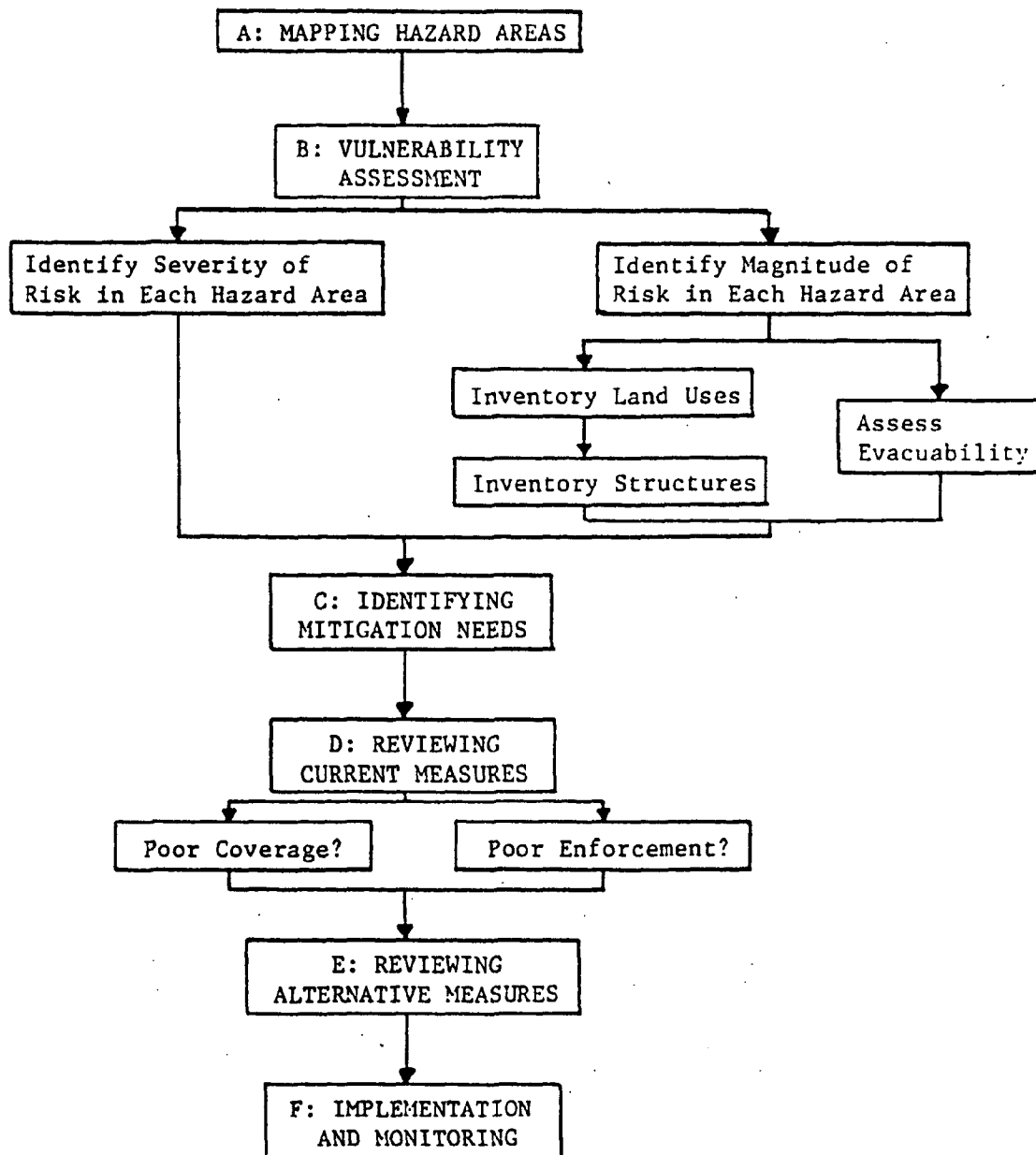
- a. Supporting narrative from Before the Storm
- b. The Beaufort County Hazard Map: Composite of Risks

Hazard areas in Beaufort County include areas of environmental concern as described in Subchapter 7H (estaurine waters, estaurine shorelines, public trust waters, coastal wetlands, and small surface water supply watershed AEC); the A, B, and C zones as designated by the Federal Insurance Administration; areas of particularly high rates of erosion (when compared to other coastal reaches surveyed (actual, documented erosion rate)) and areas with soils which are particularly susceptible to erosion.

(1) AEC's (non-mapped)

In accordance with the principles outlined in Before the Storm and with the direction of the Office of Coastal Management regarding location of AEC's, the complete set of the Flood Hazard Boundary Maps from the National Flood Insurance Program was compiled as the "Hazard Map", which ostensibly includes all the areas enumerated above.

Figure 5.1: A Process for Mitigating the Hurricane Hazard



(2) Flood Hazard Areas

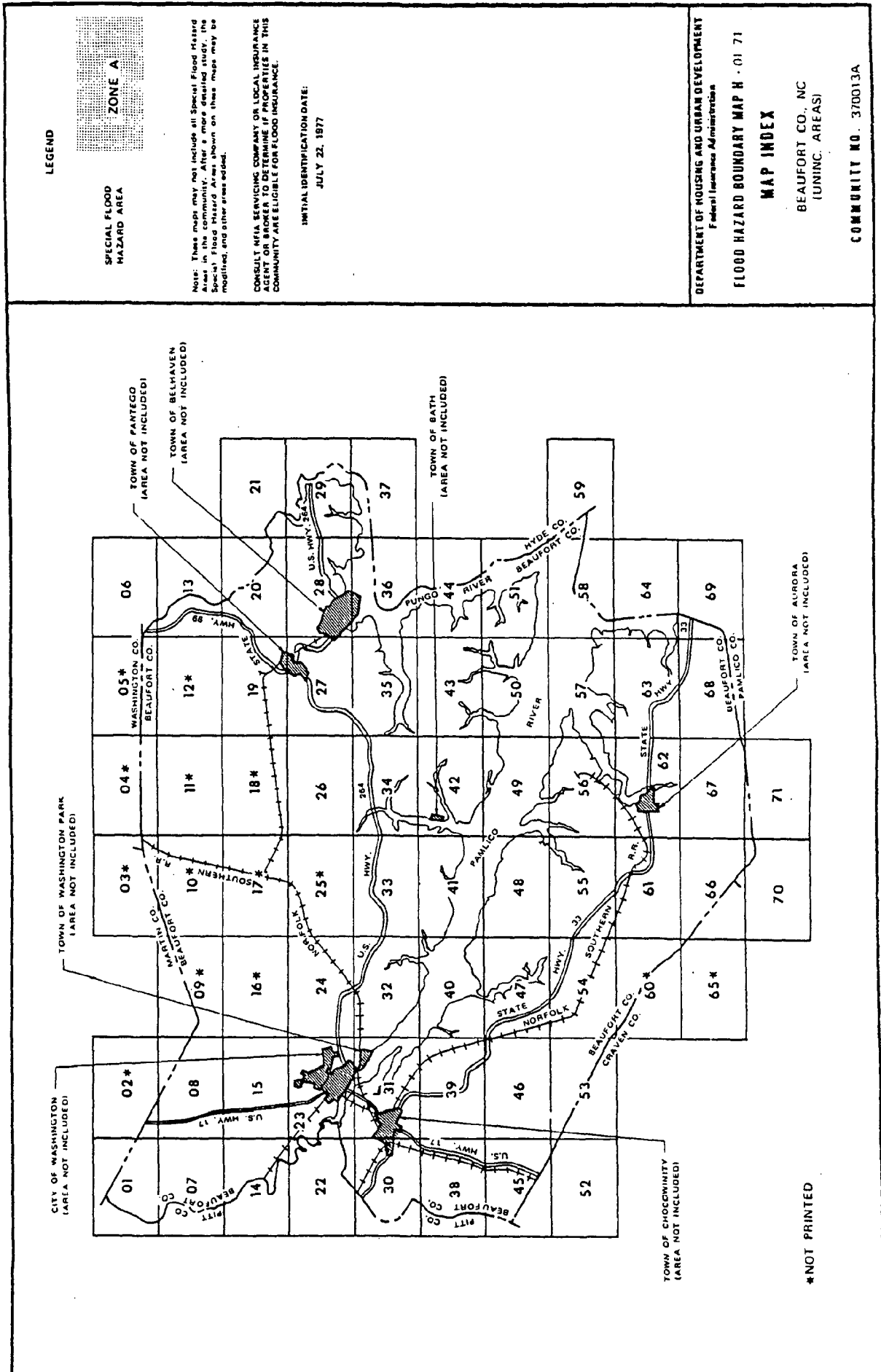
As shown in Exhibit B (key to Flood maps), a set of 71 separate maps is required to cover the unincorporated area of the County. As shown in Exhibit C (map order) a set of 12 maps is required to cover the incorporated areas of the County which are flood prone.

In order to relate to other mapped sources of data, the complete set of 83 maps was photographically reduced to the scale of the North Carolina Department of Transportation map of Beaufort County (1" = 2 miles). Thus, maps were reduced from 11" x 17" sheets to rectangles 4" x 6" (see Exhibit D) and mounted according to Exhibit B on a map sheet. This provided a base map for conducting an overlay method of hazard cognition and prioritization described below. The resulting Hurricane Hazard Map is presented further reduced as Exhibit E.

(3) Highly Erodible Areas

Identification of erosion areas was undertaken by collecting information from publishing sources, with the following results:

a. Shoreline Erosion Inventory, North Carolina, U.S. Department of Agriculture, Soil Conservation Service, Raleigh, North Carolina, October, 1975 (See Exhibit F1: Reach Map of Beaufort County and Exhibit F2: Reach Data for Beaufort County). The information in Exhibit F2 was ranked and compared to the average width lost to erosion.



12/23/83



FLOOD MAP DISTRIBUTION CENTER
8830 (A-F) SAN TOMAS ROAD
BALTIMORE, MARYLAND 21227

National Flood Insurance Program

PAGE NO. 01

ORDER NO. 83356007
SEQUENCE NO. 00011

REX TODD
PLANNING AND ALESIGN ASSOC
3715 GLENWCCD AVE
RALEIGH NC 27612

NOTES	COMMUNITY CODE	NAME OF COMMUNITY	PRIMARY BIN	QTY ORDERED	QTY SHIPPED
01	370014 A	AURORA, CITY OF	3610707	1	1
02	3700149999 1	AURORA, CITY OF		1	0
01	370015 A	BELHAVEN, TOWN OF	3610708	1	1
02	3700159999 2	BELHAVEN, TOWN OF		1	0
01	370016 A	PANTEGO, TOWN OF	3610801	1	1
02	370017 A	WASHINGTON, CITY OF		1	0
01	370017001A 8	WASHINGTON, CITY OF	3610802	1	1
01	370017003A 8	WASHINGTON, CITY OF	3610803	1	1
01	370017004A 8	WASHINGTON, CITY OF	3610804	1	1
02	3700179999 1	WASHINGTON, CITY OF		1	0
01	370268 A	WASHINGTON PARK, TOWN OF	3800707	1	1
02	3702689999 2	WASHINGTON PARK, TOWN OF		1	0
TOTAL:				12	7

EXPLANATION OF NOTES :

- 01 = THE REQUESTED MAP IS ENCLOSED. PLEASE NOTE ITS EFFECTIVE DATE.
02 = WE ARE SORRY WE CAN NOT FILL YOUR ORDER AT THIS TIME. THE MAP REQUESTED IS NOW IN THE REPRINT PROCESS. AS SOON AS COPIES OF THE MAP BECOME AVAILABLE THEY WILL BE SENT TO YOU.

Check the enclosed maps against your copy of the original order. The liability of the serving representative of NFIP is limited to correcting deficient map shipments. The serving representative assumes no responsibility for the accuracy of the maps, and is not liable for any loss or damage incurred by any map recipient caused by any inaccuracy in said maps. The legal effect of the enclosed maps is determined by publication in the Federal Register which is controlling for all purposes.

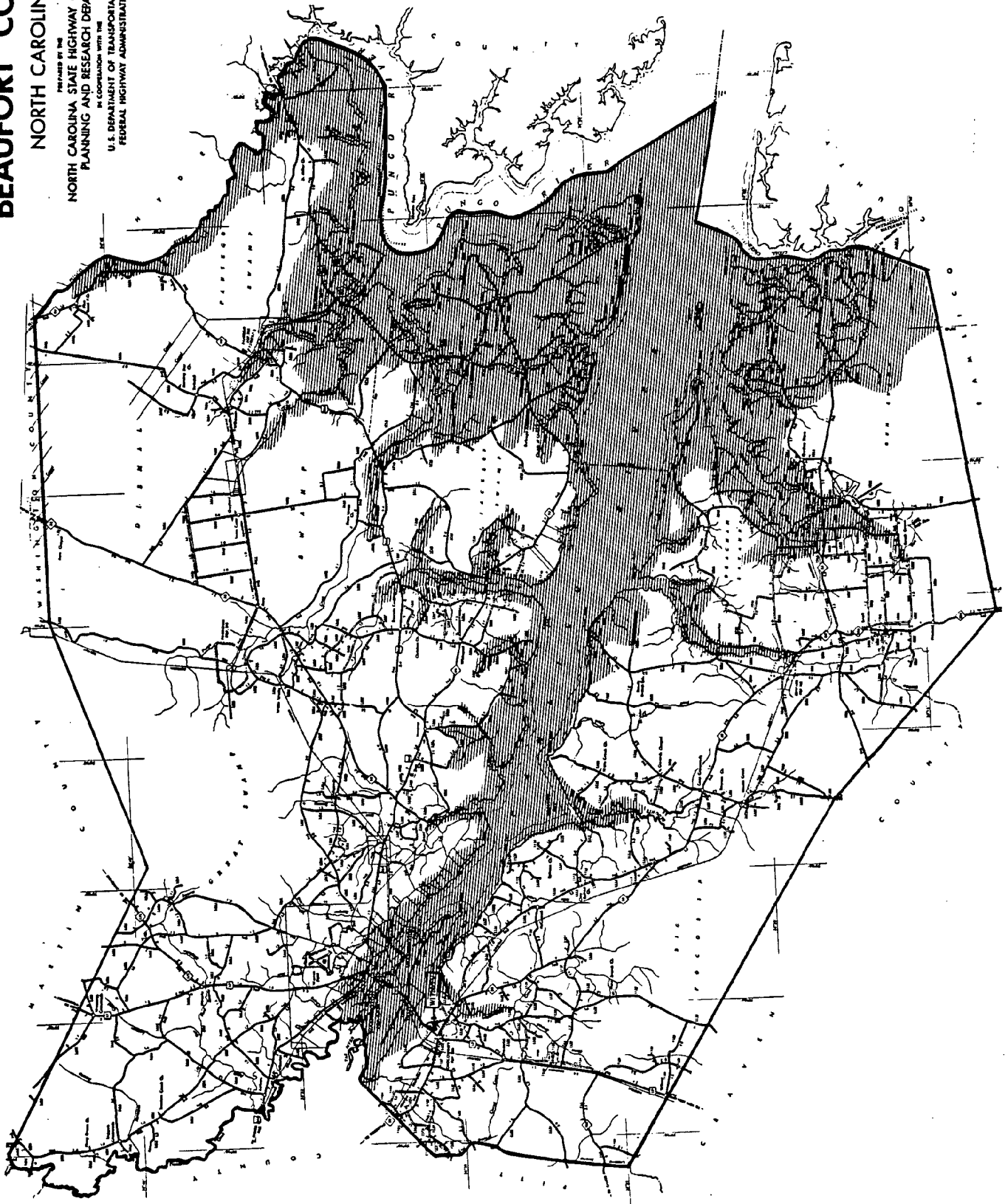
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BEAUFORT COUNTY

NORTH CAROLINA

PREPARED BY THE
NORTH CAROLINA STATE HIGHWAY COMMISSION
PLANNING AND RESEARCH DEPARTMENT
IN COOPERATION WITH THE
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

Exhibit E
HURRICANE HAZARDS MAP



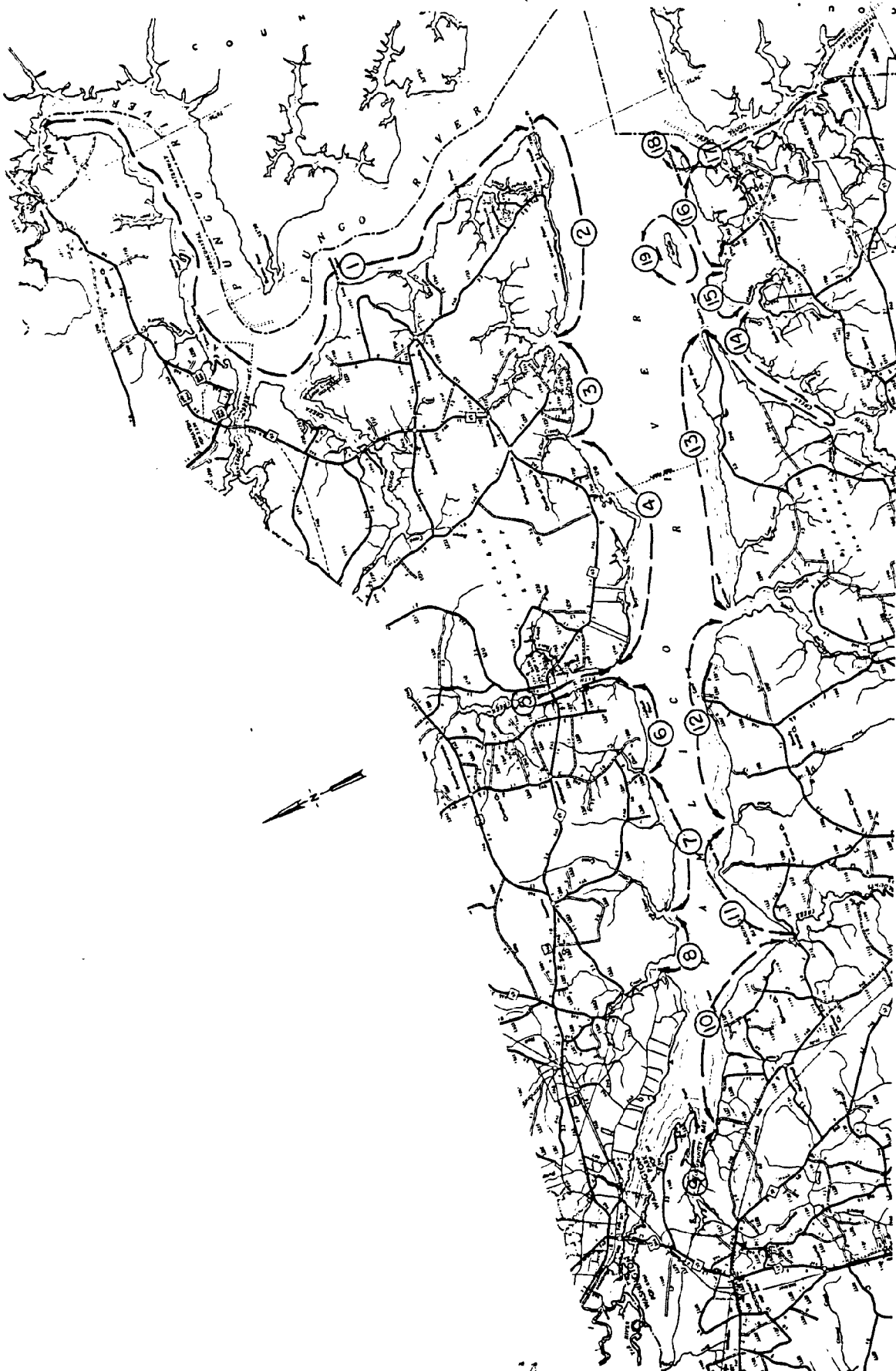
All of this erosion is occurring within the storm hazard area referenced in Exhibit E. Of the 19 reaches studies, the worst erosion occurs on the east side of the ferry (south bank) where the width of the eroded bank is 305 feet (vs. the average of 53.8 for the county) and height of the bank is 4.0 feet (vs. the average of 3.4 feet for the county). Soils there are Coxville-Rains-Othello; they support concentrated development, thereby there should be high concern for damage due to erosion.

According to these data, Beaufort County has lost 968.1 acres to erosion over a 32 year period, with an average width of eroded area (from shoreline to shoreline) of 53.8 feet. Had these shoreline acres developed residentially since 1951 at an average of 2 units per acre, by 1972, 1936 dwelling units would have been lost, at an estimated value of \$30,000 (assumed), approximately \$60 million worth of property would have been lost.

Comparison in this manner indicates that reaches 2, 4, 6, 14, 15, 16, 17, 18, and 19 are priority areas within the 19 mapped in the hazard area (See Exhibit F1).

b. District ASCS Office.

Mr. Ed Karnowski, plotted the highly erodible soils of the County and the soils where the water table is between 18 to 24". These areas, outlined on Exhibit G, helped target hazard areas.



LEGEND

---①--- REACH



BEAUFORT COUNTY

NORTH CAROLINA

REACH NO. 1

Av. width lost to erosion	46.7 feet
Av. height of bank	2.4 feet
Length of shoreline eroding	29.4 miles
Length of shoreline accreting	0 miles
Total length of shoreline	39.0 miles

REACH NO. 2

Av. width lost to erosion	77.6 feet
Av. height of bank	4.6 feet
Length of shoreline eroding	4.9 miles
Length of shoreline accreting	0 miles
Total length of shoreline	5.5 miles

REACH NO. 3

Av. width lost to erosion	42.6 feet
Av. height of bank	3.6 feet
Length of shoreline eroding	1.9 miles
Length of shoreline accreting	0 miles
Total length of shoreline	2.3 miles

REACH NO. 4

Av. width lost to erosion	59.7 feet
Av. height of bank	3.1 feet
Length of shoreline eroding	6.2 miles
Length of shoreline accreting	0 miles
Total length of shoreline	7.0 miles

REACH NO. 5

Av. width lost to erosion	25.2 feet
Av. height of bank	3.7 feet
Length of shoreline eroding	10.1 miles
Length of shoreline accreting	0 miles
Total length of shoreline	12.2 miles

REACH NO. 6

Av. width lost to erosion	59.8 feet
Av. height of bank	7.6 feet
Length of shoreline eroding	2.1 miles
Length of shoreline accreting	0 miles
Total length of shoreline	2.2 miles

REACH NO. 7

Av. width lost to erosion	23.5 feet
Av. height of bank	2.8 feet
Length of shoreline eroding	10.7 miles
Length of shoreline accreting	0 miles
Total length of shoreline	11.9 miles

REACH NO. 8

Av. width lost to erosion	53.8 feet
Av. height of bank	2.0 feet
Length of shoreline eroding	1.0 miles
Length of shoreline accreting	0 miles
Total length of shoreline	1.0 miles

REACH NO. 9

Av. width lost to erosion	57.8 feet
Av. height of bank	1.6 feet
Length of shoreline eroding	6.3 miles
Length of shoreline accreting	0 miles
Total length of shoreline	8.2 miles

REACH NO. 10

Av. width lost to erosion	52.5 feet
Av. height of bank	13.9 feet
Length of shoreline eroding	6.0 miles
Length of shoreline accreting	0 miles
Total length of shoreline	6.0 miles

REACH NO. 11

Av. width lost to erosion	55.1 feet
Av. height of bank	4.7 feet
Length of shoreline eroding	4.1 miles
Length of shoreline accreting	0 miles
Total length of shoreline	4.4 miles

REACH NO. 12

Av. width lost to erosion	31.9 feet
Av. height of bank	5.6 feet
Length of shoreline eroding	5.1 miles
Length of shoreline accreting	0 miles
Total length of shoreline	5.8 miles

REACH NO. 13

Av. width lost to erosion	55.5 feet
Av. height of bank	3.7 feet
Length of shoreline eroding	4.8 miles
Length of shoreline accreting	0 miles
Total length of shoreline	8.0 miles

REACH NO. 14

Av. width lost to erosion	69.6 feet
Av. height of bank	3.3 feet
Length of shoreline eroding	16.1 miles
Length of shoreline accreting	0 miles
Total length of shoreline	18.7 miles

REACH NO. 15

Av. width lost to erosion	76.6 feet
Av. height of bank	2.9 feet
Length of shoreline eroding	2.2 miles
Length of shoreline accreting	0 miles
Total length of shoreline	2.3 miles

REACH NO. 16

Av. width lost to erosion	116.5 feet
Av. height of bank	2.4 feet
Length of shoreline eroding	1.7 miles
Length of shoreline accreting	0 miles
Total length of shoreline	1.8 miles

REACH NO. 17

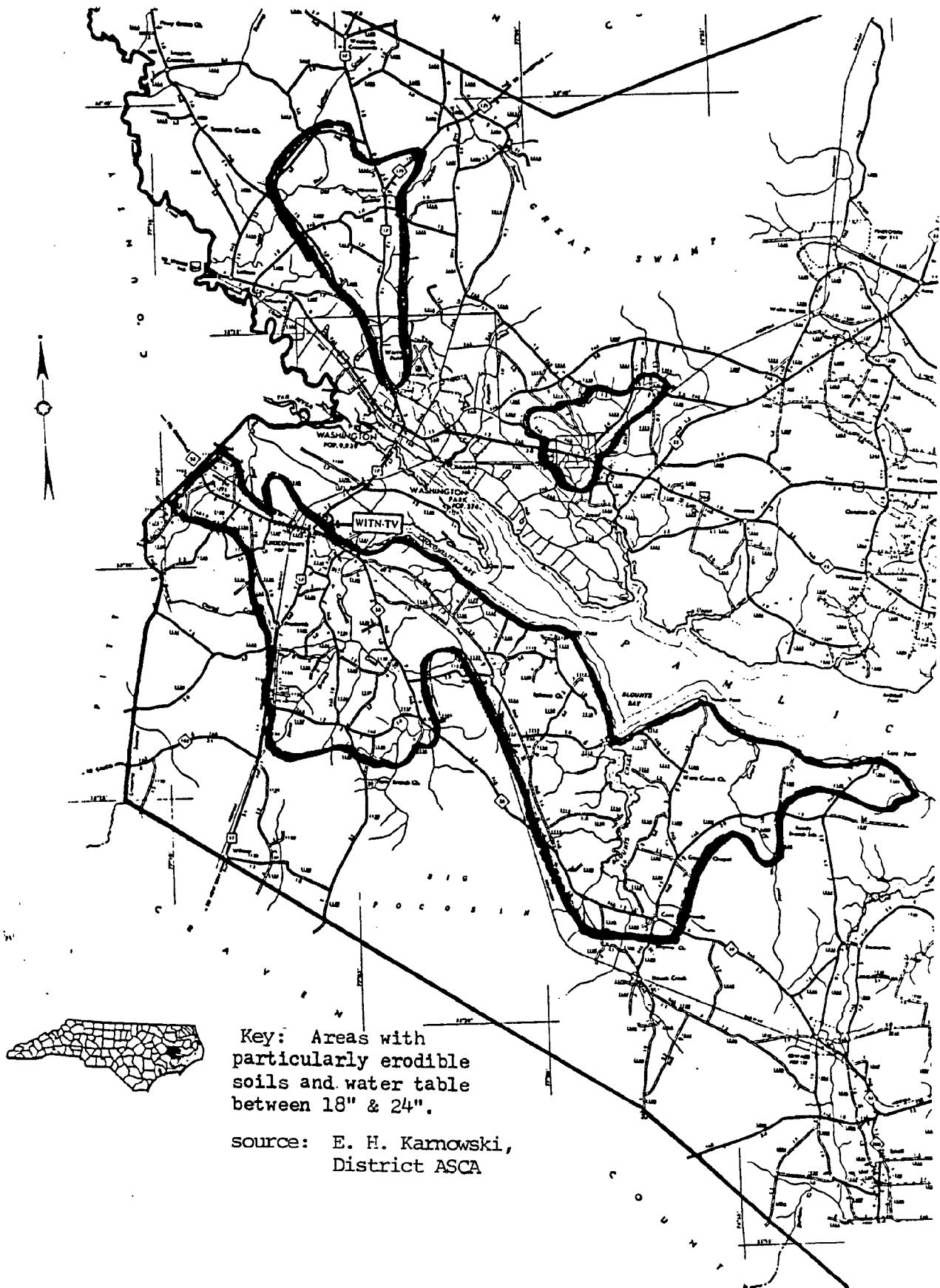
Av. width lost to erosion	58.3 feet
Av. height of bank	1.5 feet
Length of shoreline eroding	10.8 miles
Length of shoreline accreting	0 miles
Total length of shoreline	17.1 miles

REACH NO. 18

Av. width lost to erosion	82.5 feet
Av. height of bank	1.5 feet
Length of shoreline eroding	1.0 miles
Length of shoreline accreting	0 miles
Total length of shoreline	1.0 miles

REACH NO. 19

Av. width lost to erosion	102.1 feet
Av. height of bank	3.5 feet
Length of shoreline eroding	2.1 miles
Length of shoreline accreting	0 miles
Total length of shoreline	2.1 miles



c. Estaurine Shoreline Types and Erosion

Major erodible land forms along the Pamlico River System are shown on a chart produced by Dr. Stanley R. Riggs and Dr. Michael P. O'Connor of the Department of Geology and Dr. Vincent J. Bellis of the Department of Biology, East Carolina University, Greenville, North Carolina (1978). This chart, while expressly generalized for public information and education rather than definitive planning, provided an indication of where in Beaufort County the land forms (Swamp Forest, that is Cypress-Gum Swamp Forest, Cypress Fringe), Low Banks, Marshes, High Banks, and Bluffs of particular erosion significance are located. Of these types, the Low Bank, Marsh, and High Bank forms are most susceptible to erosion. Pictures of these three forms, and the narrative from that chart are presented in Exhibits H, I, and J.

Low Bank



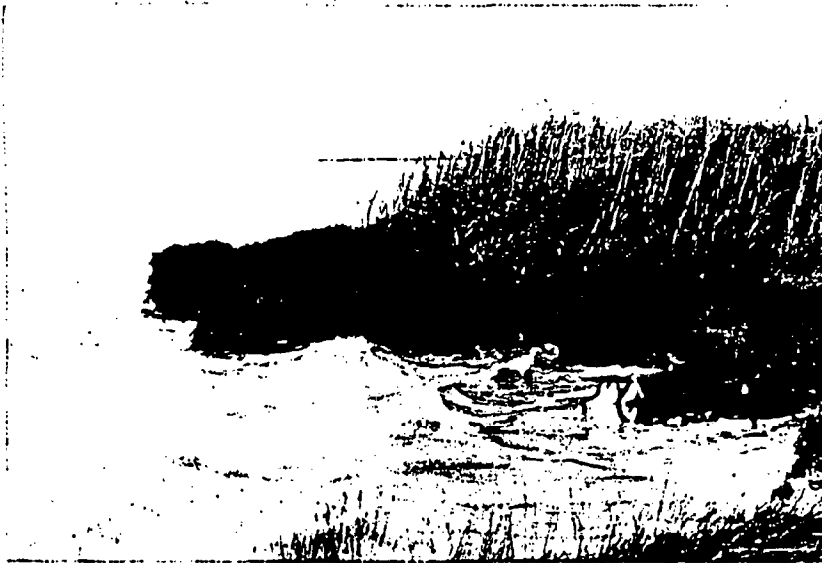
Low bank shorelines are sediment banks composed of sand and clay which have a relief of one to five feet above the normal water level. They are by far the most abundant of the sediment bank shorelines in the Pamlico River system, as well as the most rapidly eroding.

These shorelines generally consist of a sand or clayey sand sediment on top of a clay bed which occurs at or slightly below the water level. This clay bed usually occurs just below the thin surface sands in the offshore area and controls the bottom slope and water depths. Low banks are vulnerable to direct wave attack due to the general absence of a major sand beach and the lack of beach or bank vegetation. Consequently, it does not take a very high wind tide or strong storm for the waves to break directly on the bank. Eroded bank top vegetation and trees falling into the water form natural groins and energy baffles which trap minor amounts of sediment and occasionally form a nucleus where clumps of marsh grass can grow. If the scattered marsh grasses can become established and if the wave energy is not too severe, the grasses may expand to produce a fringing marsh.

These marsh grasses absorb much of the wave energy, decreasing the rate of shoreline recession.

Marsh

Marsh constitutes the most extensive type of shoreline in the Pamlico River system and in all other North Carolina estuaries. It is most prevalent on low-lying land areas with moderately saline waters in the eastern half of the Pamlico River system, and is particularly prominent in Hyde and Pamlico Counties. Abundant growths of marsh



vegetation produce a soft black organic peat substrate. The landward extent of these marshes is limited by the height of flooding caused by regular astronomical and/or irregular wind tides. The marsh is dominated by several types of cordgrass (Spartina) and black needlerush (Juncus). Marsh shorelines are generally characterized by vertical scarps which drop abruptly into one to eight feet of water. These peat scarps are the most rapidly eroding shorelines in the North Carolina estuaries. They are actively undercut by waves during periods of low water when waves break on the soft peat below the massive tangle of living grass roots. The undercut peat blocks thus formed ultimately break off and sink to the bottom. There they are slowly broken up, supplying an important source of organic detritus to the estuarine food chain.

High Bank

Pamlico River system; however, they are most commonly associated with the region west of the Suffolk Scarp. These banks, which are composed of uncemented sands, are the most susceptible to erosion. Banks composed of tight clays and iron cemented sands are more resistant. High banks are generally eroded during severe storms when onshore waves overstep the sand beach and break directly on the base of the bank. The undercut bank then overhangs the beach where it eventually collapses. These fresh sediments are reworked by the waves and temporarily broaden the beach. Fallen trees and brush act as natural groins and help to stabilize the beach. If vegetation of any form can become established either on the beach or on the bank, it will absorb much of the wave energy and decrease the rate and extent of shoreline recession.



High bank shorelines are composed of sand and clay sediments and have a relief of 5 to 20 feet above normal water level. High banks can occur anywhere within the

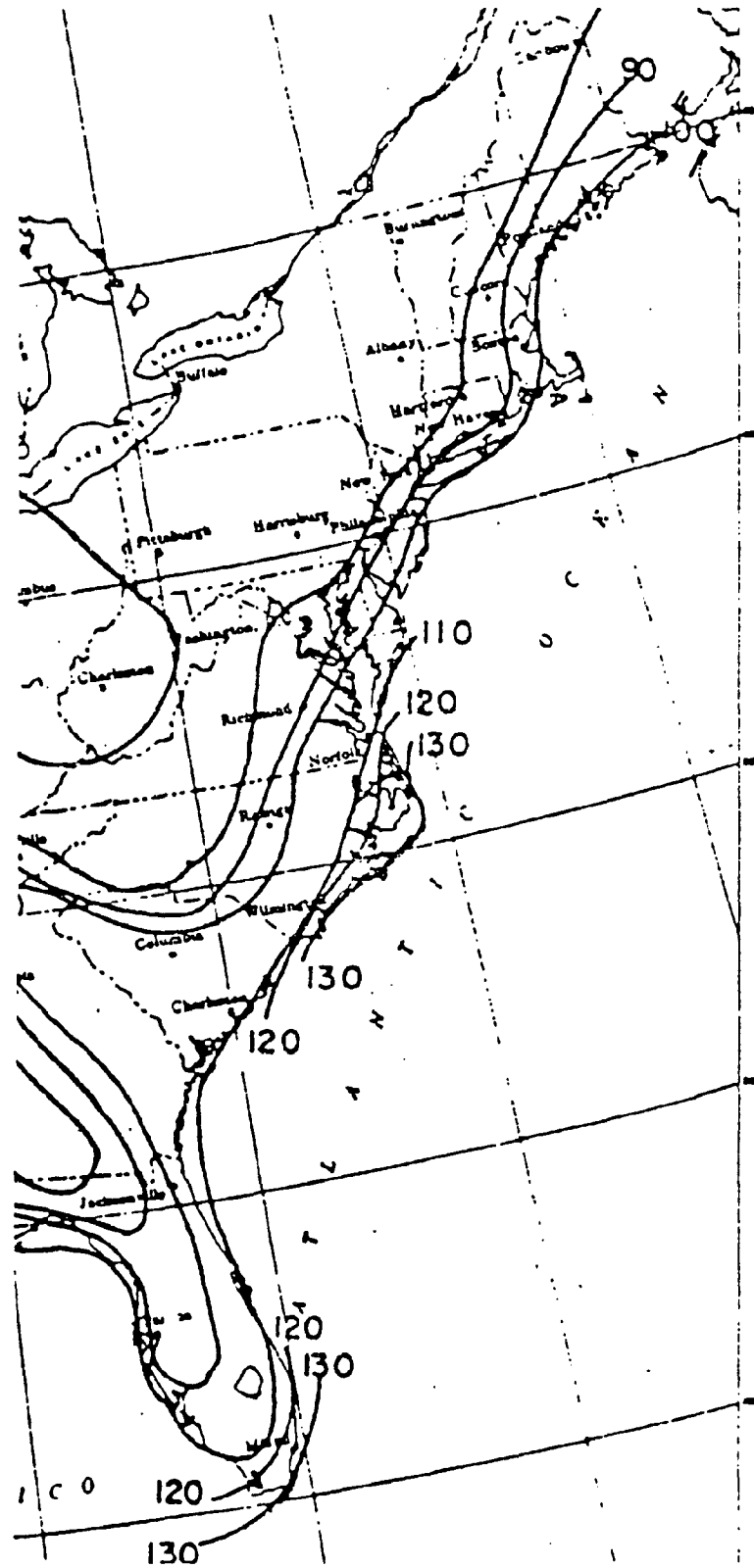
(4) Wind Hazard Areas:

While the hazard from flood and erosion is readily mappable, the entire county is equally vulnerable to the same wind velocity, because of a hurricane's size and power.

As shown in Exhibit K, Beaufort County is susceptible to annual extreme fastest mean recurrence interval of between 120 and 130 miles per hour. (The annual extreme designation means that there is a one percent chance of being equalled in any one year.)

In response to this situation, policies usually invoke the state building code, and county's supplement it with construction standards adapted to mitigate hurricane damages.

Figure 5.2: Annual Extreme Fastest Wind Speed in Miles Per Hour
(39 Feet Above Ground, 100-Year Mean Recurrence Interval)



Source: Dames and Moore, 1981, p. 42.

3. Assessing the County's Vulnerability to Hurricane Damages

Once a community like Beaufort County has identified those areas which are most subject to hurricane forces, it can begin evaluating the level of hazard present throughout the community. Such an assessment of the community's vulnerability to hurricane damages is necessary for identifying the most important hurricane-related problems in the community and in targeting the community's hazard mitigation efforts to its most vulnerable areas.

A comprehensive assessment of the community's vulnerability to hurricane damages must include an identification of both the severity and magnitude of risk that exist in each hazard area. The severity of risk is basically a function of the number of physical forces (storm surge, wave action, etc.) that a hurricane is likely to impose on a particular hazard area. The magnitude of risk is basically a function of the size of the population and the number and value of developed properties exposed to hurricane forces within a hazard area. Put another way, if no development existed in hazardous areas, little would be at risk -- either public investments such as water systems, and sewer systems, or private investments such as homes and businesses.

a. Severity of Risk

Exhibit L ranks the severity of risk in each of Beaufort County's hazard areas according to the damaging forces which are likely to occur there. This breakdown is part of the basis for the ranking of the different hazard areas which appear in Exhibit E.

Exhibit L: Severity of Risk in Hazard Areas

Hazard Area	Exposure to Damaging Forces				
	Severity Rank	Erosion/ Scour	Wave Action/ Battering	Flooding	High Wind
Estuarine Shoreline AEC	1	•	•	•	•
"Weak spots" *	*	*	*	*	*
Wetland AEC	2	o	•	•	•
A-zone	3			•	•
Rest of Community	4				•

Exposure Level: High (•), Moderate (o), Low ()

Beaufort County's estuarine shoreline AECs will bear the full force of a hurricane since they lie directly on the land-water interface and are among the most dynamic features of the coastal landscape. Shoreline erosion poses day-to-day hazards for coastal development; hurricanes and other major storms accelerate these processes so that drastic changes in the local landscape can occur in a few hours. During a hurricane, estuarine shoreline areas will be subject to severe erosion and scour, direct wave action, battering by debris, inundation by the storm surge and high winds. The coastal wetlands of Beaufort County will be subject to wave action, flooding, and high winds, but are less susceptible to erosion.

*Weak spots are areas outside the mapped areas which have particular characteristics of vulnerability to hurricane damage. They include overwash areas or drainage channels which are repeatedly inundated during major storms.

The A-zones are those parts of the county which have a one percent chance of being flooded in any given year. During severe storms, some undermining of structures has been known to occur as flood waters rise and recede. (Note: These A-zones comprise the Hurricane Hazard Area, Exhibit E.)

All other sections of the County will be subject to high winds but should remain relatively safe from the damaging water forces of a hurricane. Of course, a catastrophic hurricane in the form of a Beaufort County landfall can unleash the full complement of damaging forces beyond the boundaries of any hazard area.

b. Magnitude of Risk

Identifying the magnitude of risk in Beaufort County required identifying the characteristics of development with each hazard area by performing a basic inventory of land uses and structures, and required assessment evacuability.

(1) Inventory of Land Uses

This inventory, which involved 64 man-hours of effort to complete, took place on every major road within the shaded area of Exhibit E, the Hurricane Hazard Area Map. This inventory will give local residents and administrators a clear picture of the types and levels of development exposed to different levels of hazard, thus pointing out particular areas or issues of concern.

The first level of analysis is an inventory of land use within the hazard area. Because of the scale of mapping and the monumental task of

inventorying at the County level, types of land use, trends, and patterns were obtained from existing information, primarily the Beaufort County Land Use Plan, Land Use Map (1976) and the Land Classification Map from the 1982 LUP.

The 1976 Land Use Map was used to obtain a historical perspective of uses, intensities, and patterns of development. Comparison with the 1982 Land Classification Map (See Exhibit M) revealed shifts in concentration and moreover, plans for future shifts. This comparison showed that most of the County's urban or "developed" area is within the area of most risk (the hazard area), and the majority of the future plans for intense development is planned to take place in the mapped hazard areas. These shifts identify that the counties' shorelines are being developed even in the face of inherent "risks" due to natural forces; wind, wave action, etc.

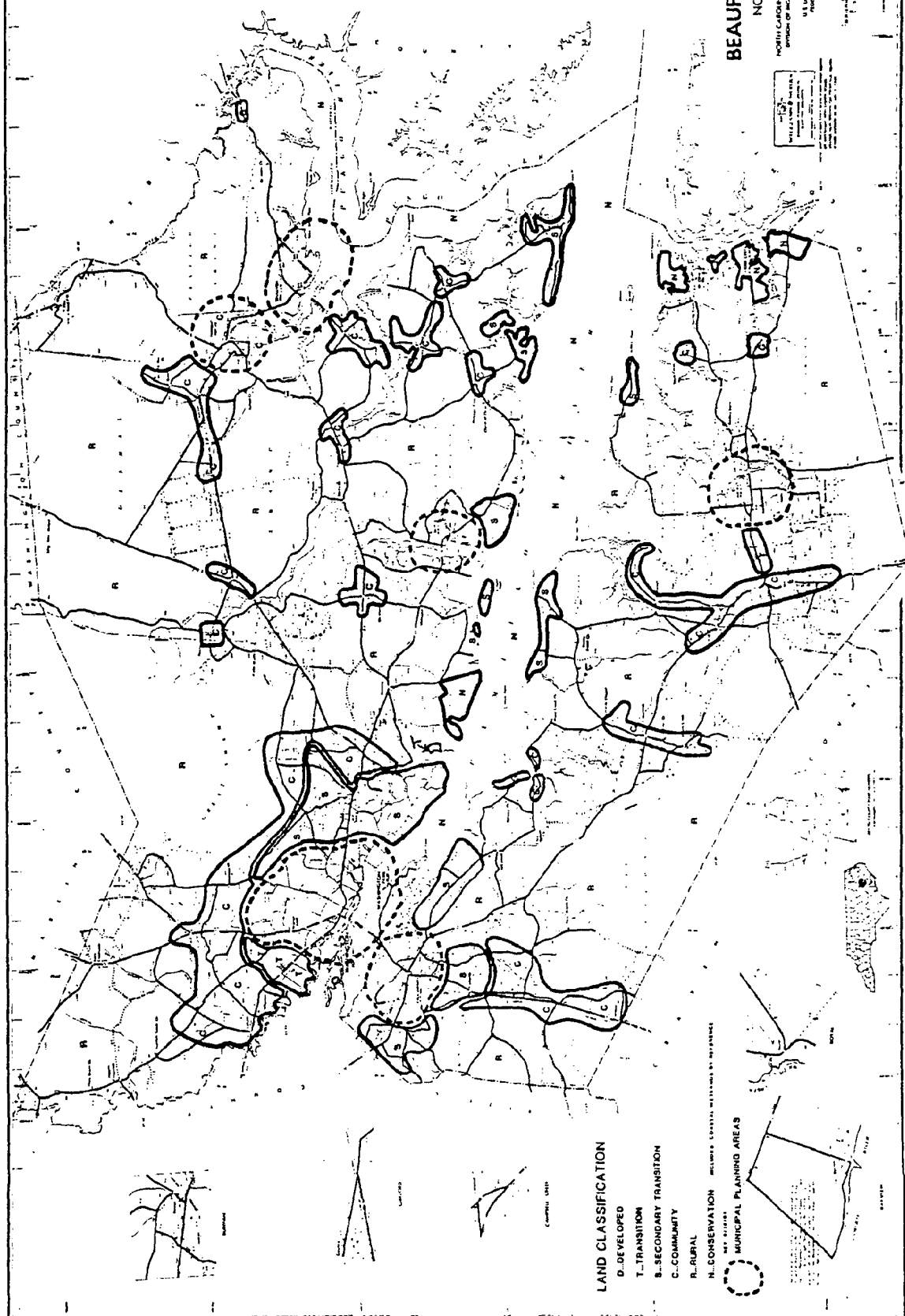
Beaufort County is like every other coastal area in its pressures for waterfront development. As can be seen from the hazard map, nearly every waterfront lot in the County is within the hazard area. An undeveloped hazard area poses no risk to development, but once the area develops, the risk increases and will call for some means of hazard mitigation.

(2) Inventory of Structures

The second level of analysis for identifying the magnitude of risk is an inventory of structures in each hazard area. The structural inventory for Beaufort County was divided into a residential inventory, a commercial inventory, and a public facilities inventory.

BEAUFORT COUNTY
NORTH CAROLINA

U.S. DEPARTMENT OF TRANSPORTATION
FOR HIGHWAYS - PLANNING, AND RESEARCH



The inventory of residential structures concerned itself with number of dwelling units, whether they were built above the flood level (first floor elevation of more than 10 feet above MSL), whether they were mobile homes or not, and a windshield estimate of market value. Information regarding density was obtained from the aforementioned land use map and land classification map, making assumptions about the intended densities within designated land classes. All other things being equal, a more densely developed hazard area presents a greater risk of damages than a less densely developed hazard area.

The inventory of commercial structures was similarly concerned with count, and square feet of facility (relative size), and an estimate of the replacement value of the structure. Beaufort County has a stake in ensuring the safety of commercial establishments from hurricane damages; the more damage that is sustained by the business sector, the greater will be the economic disruption caused by a hurricane and the longer it will take the County to recover.

The inventory of public and private facilities, utilities, and private institutions serves two purposes: (1) it provides a basis for assessing the ability of essential community services to function during and after a hurricane disaster, and (2) it helps guide the County Commissioners in the siting and design of public buildings and utilities. Facilities located in a particular hazard area should be designed to withstand the damage forces expected in that area. This is especially true for facilities which play a key role in disaster response operations and are essential to quick community recovery, such as primary roads, water, sewer, electrical, and telephone

facilities, police stations, fire stations, town halls, the court house and schools. The facilities inventory in Beaufort County helped identify the location of each facility relative to the different hazard areas, the facility's ability to withstand the damage forces expected in its hazard area, and the facility's replacement value. There is an absence of "public facilities" (water, sewer) in most of the unincorporated areas of Beaufort County. Private "group facilities" include the water system in Bayview and proposed package treatment facility in "Pamlico Plantation".

Exhibit N presents in summary form the results of these inventories in the unincorporated areas of Beaufort County.

EXHIBIT N

INVENTORY OF STRUCTURES IN THE HAZARD AREA

UNINCORPORATED AREAS (buildings only - no land values)

sub-area	Conventional homes	Dbl-wide Mobile home	Sng-wide Mobile homes	Institution	Commerc.	Ind.	Util.
Northern Shore of river	1642	33	494	25	44	2	2*
Southern Shore of river	<u>669</u>	<u>245</u>	<u>373</u>	<u>4</u>	<u>49</u>	<u>1</u>	<u>0</u>
TOTAL	2311	278	867	45	164	3	2
Median Value	\$42,000	\$20,000	\$8,500	\$45,000	\$20,000	\$40K	\$40K
Total Value in millions	\$97.062M	\$5.56M	\$7.3695M	\$2.025M	\$3.28M	\$.12	\$.20
Grand Total Value:							
Grand Total Value: \$115,616,500 (not counting cities), 1982 adjusted for 1983 to \$127,178,150.							

* These utilities include the "group facilities" in the county, such as the private water system in Bayview and would include the proposed package treatment facility at Pamlico Plantation.

Note: Detailed data for Exhibit N was collected by state road numbers and by map keys (See Exhibit B), since the planning unit had become the individual flood hazard boundary map (or cell in Exhibit B). This detailed data is available in the County Emergency Management Office.

Similar to the inventory for the unincorporated area, an inventory of the portion of the municipalities was undertaken. Exhibit O presents summary findings:

EXHIBIT O

INVENTORY OF STRUCTURES IN THE HAZARD AREA

INCORPORATED AREAS (buildings only, no land values)

sub-area	Conventional homes	Dbl-wide Mobile homes	Sng-wide Mobile homes	Institution	Commerc.	Ind.	Util.
Northern Shore							
Washington (3395)	1135	137	426				1
Washington Park (213)	142						0
Pantego (82)	22	3	8	5	11	0	1
Belhaven (961)	643	77	241	16	71	0	2
Bath	<u>24</u>	<u>0</u>	<u>0</u>	<u>1</u>	<u>6</u>	<u>0</u>	<u>1</u>
Subtotal:	1966	234	729				
Southern Shore							
Chocowinity (277)	0	0	0	0	0	0	1
Aurora (302)	<u>101</u>	<u>12</u>	<u>38</u>				<u>1</u>
Subtotal:	101		38				<u>2</u>
TOTAL:	<u>2067</u>	<u>246</u>	<u>767</u>				
Median Value	\$42K	\$20K	\$8.5K	\$45K	\$20K	\$40K	\$40K
Total Value in Millions	\$86.81	\$24.62	\$6.52				

Note: Detailed data were collected for commercial structures and public facilities. Housing counts (except Bath) are estimated based upon percentage of city's municipal limits is within the hazard area times the 1980 census housing unit count. Estimates of mobile home count (both double and single wide) was obtained by applying the percentages for same derived from Exhibit II and applied to the municipal count. (Conv. homes = .6687; Double-wide = .0804; single-wides = .2509)

In summary, then, by adding the grand totals for the value of property in the hazard area (unincorporated, Exhibit N) and the value of same in the hazard area (incorporated, Exhibit O), it is estimated that \$227,941,500 worth of residential structures alone is at considerable risk from hurricane hazard.

(3) Assessment of Evacuability

Analysis of evacuability in Beaufort County involved setting up four analytical constructs: the identification of major evacuation routes, the establishment of evacuation zones, the identification of storm surge inundation points (that is, areas on the roadway that become flooded first in the early periods of a storm) along the major routes, and the calculation of preliminary evacuation times.

(a) Evacuation Zones. -- Demand for Evacuation Capacity

As defined in Stone¹, evacuation zones are "delineations of the vulnerable areas with common hazard vulnerability and common evacuation routes" (p.6).

Based upon the assessment of magnitude and severity of risk of hurricane damage, the location of major evacuation routes, the update of the County's Evacuation Shelter Plan, and the years of experience of the Emergency Management Coordinator (Mr. Daden Wolfe) and that of the recently retired Coordinator for the Area A of the Division of Emergency Management, Col. David W. Spivy, eight evacuation zones were established (see Exhibit P).

¹ John R. Stone, Hurricane Emergency Planning: Estimating Evacuation Times for Non-Metropolitan Coastal Communities, UNC Sea Grant College Program Working Paper 83-2, NCSU, Raleigh, NC 27650.

BEAUFORT COUNTY

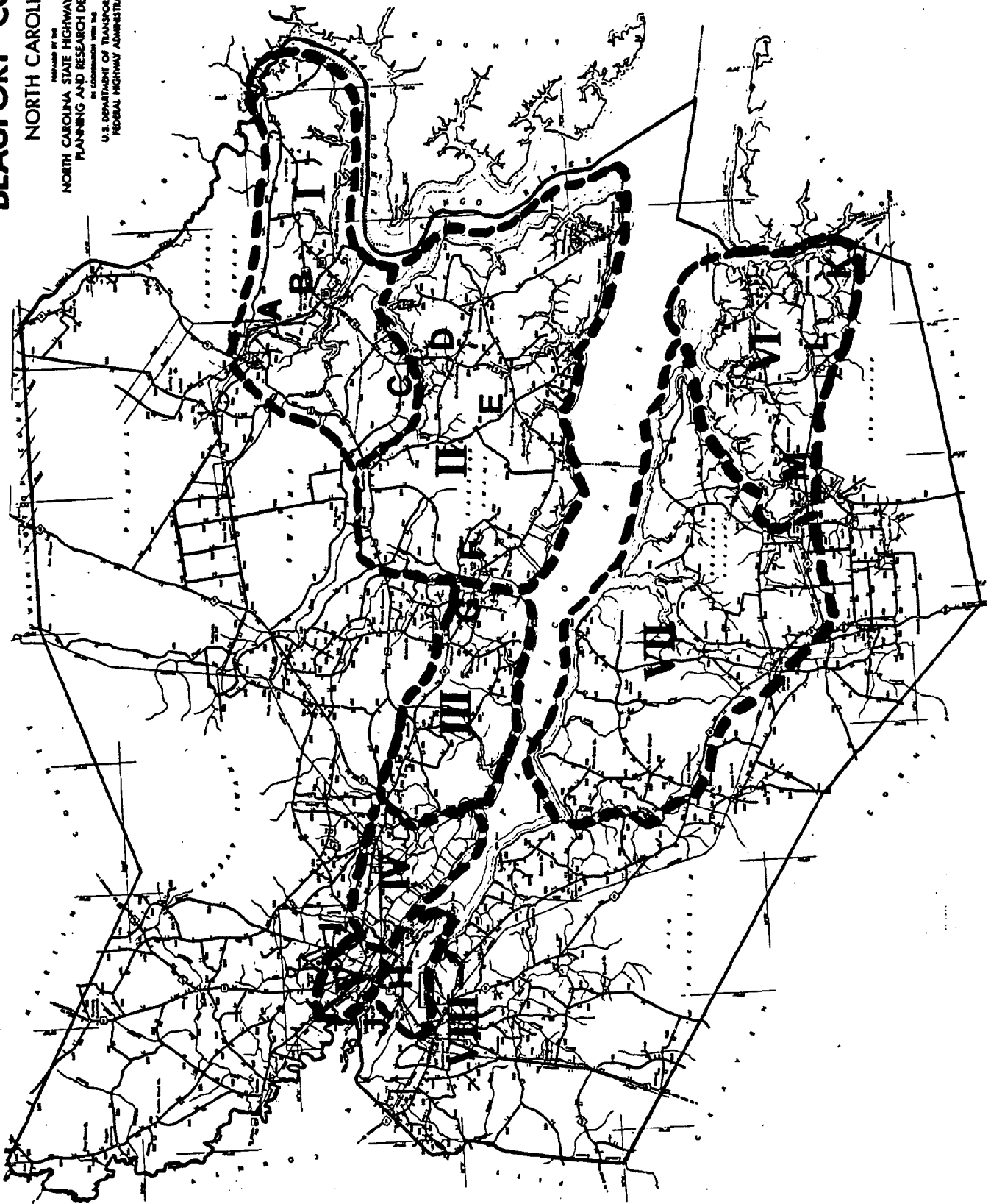
NORTH CAROLINA

PREPARED BY THE
NORTH CAROLINA STATE HIGHWAY COMMISSION
PLANNING AND RESEARCH DEPARTMENT
IN COOPERATION WITH THE
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

Exhibit P

EVACUATION ZONES (I-VIII)

SURGE INUNDATION POINTS (A-M)



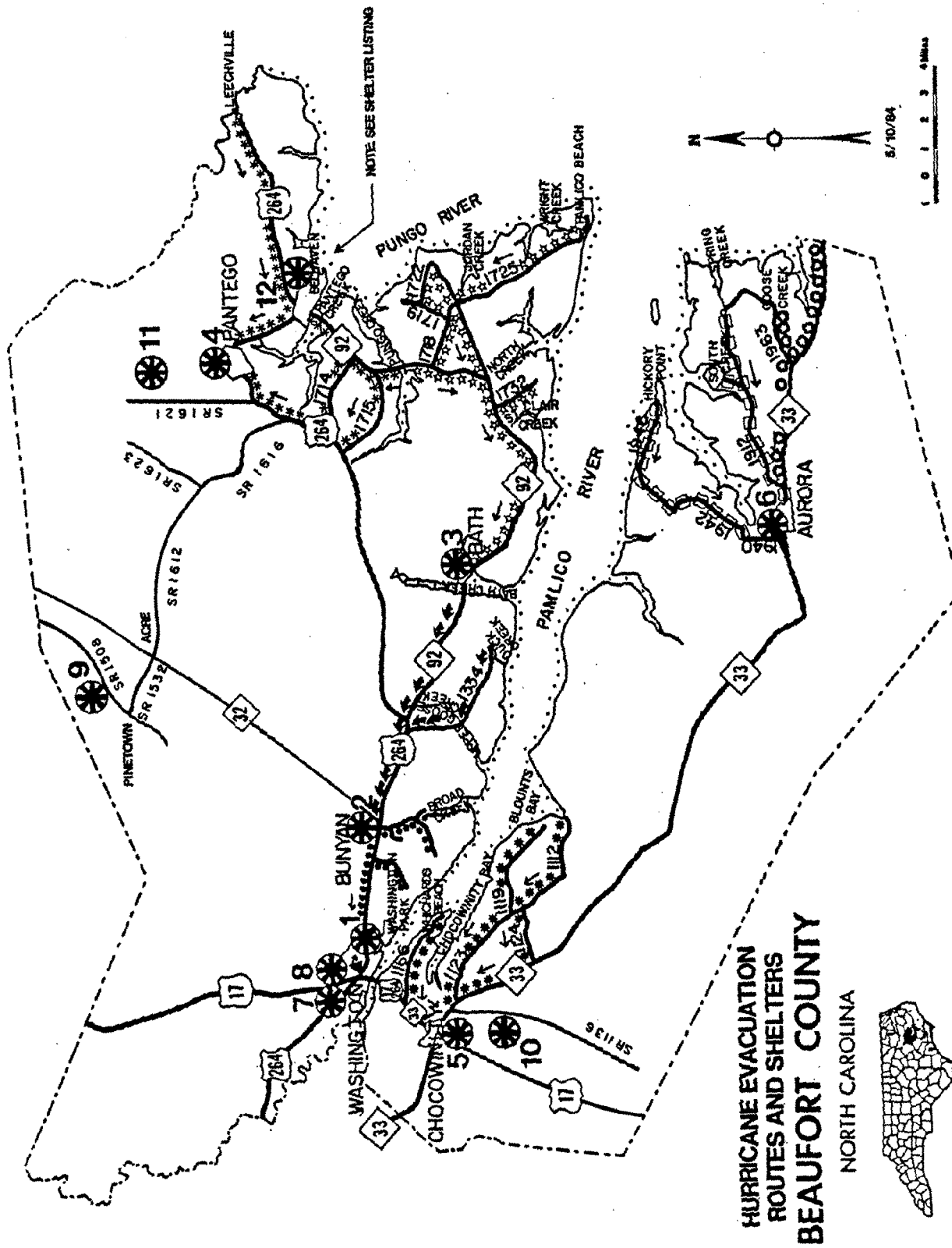
(1) County-wide

The first consideration is the population in the entire hazard area (Exhibit E) which will need to be evacuated. To arrive at a working figure in Beaufort County, the number of housing units (from Exhibit N plus Exhibit O: 6,536) was multiplied by the County's 1980 census count for persons per household (2.37), rendering an at-risk population of 15,490. Since the July, 1982 population for Beaufort County (41,836) is 3.67% larger than the 1980 census figure, we apply this increase to the at-risk population ($15,490 \times 1.0367$) to estimate a 1983 population at-risk of 16,058. This amounts to 38.38% of the County's people residing in the hazard area. (This number, of course, fluctuates at different times of day and at different times of year, and with consideration of whether population is counted in commercial establishments (the workforce) or residences, as calculated here). If a hurricane struck at night, as in the recent tornado disasters, more people would be at risk, whereas if it struck at day, possibly fewer would be at risk. At any rate, there is considerable potential for loss of life from storm hazard in Beaufort County.

The county should also keep in mind that it may also be the recipient of out-of-county evacuees from Hyde, Pamlico, etc. and these "swells" may further affect the actual times needed to evacuate the population.

(2) Within each evacuation zone.

Exhibit P presents a map of the eight evacuation zones, overlaid with the grid system from Exhibits B and E. This area coincides with the County's Evacuation Routes and Shelter Plan (see Exhibit Q).



BEAUFORT COUNTY
HURRICANE EVACUATION ROUTES AND SHELTERS

<u>AREA</u>	<u>ROUTES</u>	<u>SHELTER</u>
1	West End of Washington take nearest route to 15th Street, then East on 15th Street. East End of Washington take nearest route to Charlotte Street, North on Charlotte to 264, East on 264.	Eastern Elementary School, 264 East and Hudnell Street
2	Washington Park and East of Washington Park to Broad Creek, take Brick Kiln Road to 264, West on 264.	Beaufort County Technical School Bunyan
3	Upper Goose Creek, Duck Creek, West Side of Bath Creek take nearest route to 264 then West on 264.	Bath High School
4	East Side Bath Creek, St. Clair Creek, North Creek, Pamlico Beach, Wright Creek, Jordan Creek, take 92 to Bath.	Pantego High School
5	Pungo Creek nearest route to 264, 264 East to Pantego, Leechville, Belhaven take 264 West to Pantego.	Chocowinity High School
6	Whichards Beach 1166 to U.S. 17, U.S. 17 South to Chocowinity. Chocowinity Bay to Blounts Creek Bay nearest route to 33, then 33 West to Chocowinity.	Aurora High School
7	Hickory Point 1946 to 1942, 1942 to 1940, 1940 to Aurora. South Creek, Spring Creek 1912 to Aurora, Campbell Creek West on 33.	John Cotten Tayloe School
8	Township 4 (Goose Creek Island) Pamlico County, Take State Road 33 to Aurora. If Aurora shelter is filled then continue on 33 to Chocowinity.	National Guard Armory
9	Take nearest route to Pinetown-Residents in area.	Pinetown Elementary School
10	Residents from eastern area of county (southside of river) take nearest route to 33 then west to Chocowinity	Chocowinity Primary School
11	Overflow Pantego/Belhaven area	Beaufort County Elementary School
12	These shelters <u>will not</u> be utilized in a hurricane <u>threat</u> to Beaufort County due to rising water. May be used as needed for other disasters.	Belhaven High and Elementary School

BEAUFORT COUNTY
INSTRUCTIONS FOR EVACUEES

When your local government advises evacuation, keep calm, and follow these procedures promptly:

1. Shut off main gas valve and pull main power switch before leaving home.
2. Head for the designated shelters or evacuation points indicated for your area, as directed on your Evacuation Plan maps and by broadcasts during the emergency. Follow routes indicated on maps. Drive up to shelter entrance, unload, and park car as police instruct. If on foot, proceed to nearest loading station and board busses. No fare will be charged.
3. Take only clothing, food, and special medicine that is necessary; do not try to bring household equipment. Evacuated areas will be policed to prevent looting.
4. Follow instructions of shelter personnel, and volunteers to help with any tasks needed for efficient shelter operation.
5. Remain at the shelter until informed that you may leave. People will not be allowed back into evacuated areas until advised by official public announcement.

Questions should be directed to the Beaufort County Emergency Management Coordinator, P.O. Box 124, Washington, North Carolina 27889
(Phone: 919/946-2046).

(b) Evacuation Routes - Supply of Evacuation Capacity

Ideally, these routes would be subject of a Road Network Capacity and Demand Analysis¹ and each of the critical points would be the subject of an Evacuation Analysis². However, because of the limited scope of this study, information will be provided which allows the Board of Commissioners to direct energy toward the most severe capacity limitations first.

/1/ Roadway Capacity Information

Supplementing the information presented in the Beaufort County Land Use Plan, the capacities of the primary roads are presented in Exhibit R. These figures are based on a free-flow situation of typical traffics at 35, 45, and 55 mph.

Exhibit R
UTILIZATION OF PRIMARY ROADS
1974 - 1980

Road	Pavement Width	Design Capacity			24 hr. Average		1980 Percent Utilization
		35 mph	45 mph	55 mph	1974	1980	
US 17	24 ft	10,920	7,500	3,000	6,900	7,981	73%
US 264	24 ft	10,920	7,500	3,000	5,400	5,564	51%
NC 32	24 ft	10,920	7,500	3,000	1,550	1,165	11%
NC 33	24 ft	10,920	7,500	3,000	2,450	2,455	23%
NC 99	16 ft	7,150	4,500	1,800	1,200	1,250	17%
NC 92	16 ft	7,150	4,500	1,800	1,425	1,337	18%
NC 306*	22 ft	9,060	6,200	2,400	900	1,398	15%

* Ferry can handle a maximum of 380 automobiles per day.

SOURCE: N.C. Department of Transportation, from the Beaufort County
CAMA Land Use Plan, 1981; Dr. Marion R. Poole, 1984.

¹ Carrying Capacity Study, Currituck County, UNC-CH, 1983, p. A-30.

² Ibid., p. A-25.

Worksessions with the Emergency Management Coordinator and the recently retired Area A Coordinator indicate that these capacities are adequate for evacuation purposes, unless the routes are inhibited at the critical "surge inundation points". It is clear to both these persons that while elevation is the fundamental factor in such surge points, adequate warning time is the primary factor in using the adequate roadway capacity illustrated above.

/2/ Surge Inundation Points

Exhibit S below presents the twelve most important blockage points along the County's evacuation routes, by evacuation route and zone. Identified by the Emergency Management Coordinator and the former Area A Coordinator, they represent primary focal points in the County's evacuation implementation strategy and policy development. (Points A - L refer to Exhibit P.)

EXHIBIT S SURGE INUNDATION POINTS

Evacuation Area	Major Evacuation Routes in this area	Critical Area and Points
I	Hwy. 264 By-Pass	Stretch of 264 .25 miles on either side of lower Dowery Creek culvert near intersection of SR 1709.
		Portion 1 mile east of the intersection with Hwy. 92 in Belhaven, to that intersection.
	Business 264	Portion inside Belhaven.
	Hwy. 264 By-Pass	Portion 1.5 miles on either side of <u>Cuckolds Creek Bridge</u> toward Pantego (Point A).

	Hwy. 92	From intersection with 264 in Belhaven to Sidney Crossroads, over the <u>Pantego Creek Bridge</u> , (Point B), the <u>Pungo Creek Bridge</u> , (Point C).
II	Hwy. 92	Portion from <u>Pungo Creek Bridge</u> to Sidney Crossroads, over the <u>Jack Creek Bridge</u> (Point D). Portion from the <u>St. Clair Creek Bridge</u> (Point E) to a point approximately 1 mile east of SR 1734 (to Bayview). <u>The Back (Point F) and Bath Creek Bridges (Point G) at Bath.</u>
III	Hwy. 92	none
	Hwy. 264	none
IV	SR 1300	Portion of State Road 1300 that feeds 264, and all State Roads that feed SR 1300, from Broad Creek to Washington (through Washington Park) across <u>Runyons Creek Bridge</u> on Park Drive in Washington (Point H).
	Hwy. 264	Portion .25 miles on either side of <u>Runyons Creek Bridge</u> (Point I).
V	Hwy. 264	Area inside the flood hazard area inside Washington (that is, the area from an imaginary line drawn from the intersection of Oak Drive & Hillcrest Drive due west to where it would intersect Hwy. 17, south to and including the <u>Pamlico River Bridge</u> . (lower half of city)(Point J.)
VI	Hwy. 33	From the Pamlico County line to Campbell Crossroads, including crossing the <u>Smith Creek Bridge</u> (Point K) and the <u>Campbell Creek Bridge</u> (Point L).
VII	Hwy 33	none

VIII

Hwy. 33

From the Chocowinity City limits
to the Pamlico River Bridge.

SR 1166

Entire road from Oak Point to
Hwy. 17 intersection, and all
feeder roads.

/3/ Evacuation Time, Methodology

Ideally, all of these critical points would be the subject of detailed "surge roadway inundation analysis," consisting of a time history study of the expected time of inundation of each critical point on each evacuation route, relative to hurricane landfall (Stone, page 6). However, since such detail is well beyond the scope of this initial work, several priority surge inundation points (A, B, E, F, G, K, and L) along three major evacuation routes (NC 264, NC 92, and NC 33) have been selected for estimation of "Preliminary Evacuation Time".

In order to develop these preliminary estimates of the time required to evacuate each of the Beaufort County Evacuation Zones, the methodology developed in UNC Sea Grant College Publication UNC-SG-83-2 is applied (Hurricane Emergency Planning: Estimating Evacuation Times for Non-Metropolitan Coastal Communities, John R. Stone, PhD., NCSU, Raleigh, N.C., April 1983). Many of the assumptions used in that methodology were applied in Holden Beach. Stone's method is accepted for Beaufort County's preliminary analysis, in instances where similarity of capacities and other conditions were judged strong enough. In other cases, such as road capacity and traffic demand, data from Beaufort County is used.

Any use of this analysis for strategic planning of evacuation route improvement must refine this application beyond this preliminary stage. We use it here to (1) present how such a method can be used, (2) to determine preliminary "broad-brush" estimates of evacuation time, and (3) to illustrate how bottlenecks constrain evacuation routes.

The methodology itself is outlined (stepwise) below.

Exhibit T

. Cut-off Time

A complete analysis for the surge and gale-force wind hazards time components of evacuation time would require a computer simulation of the storm. However, the Saffir/Simpson Scale description of a Category 4 storm suggests that low-lying escape routes may be cut by rising water as early as three to five hours before the hurricane eye arrives.* This estimate for roadway inundation time is consistent with a storm which moves at a typical 10 mph forward speed and has a surge that extends about 30 miles out from the hurricane eye. The estimate also seems reasonable as a "worst case situation" for Beaufort County since the approaches to many of its bridges are at low elevations.

Gale-force winds and blinding rain can also combine to make it virtually impossible to drive a vehicle on an evacuation route. Wind analysis for barrier islands and coastal areas in Florida suggest that gale-force winds may precede landfall of the eye by six hours.

Since Beaufort County is not a barrier island, we assume the lower end of the range will be required for evacuation, that is, 3 hours.

. Mobilization Time

The mobilization time for a community may vary somewhat. However, actual data suggests that it may take over five hours for everyone to begin the evacuation. A value of three to four hours would find 80% to 90% of the evacuees on their way. We select the midpoint of this range (3.5 hours) for this Study of Beaufort County.

. Travel Time

Evacuation travel is based on the length of the evacuation route and the assumed uninterrupted operating speed of the evacuation vehicles. For each surge inundation point, we assume a starting point at the eastern most end of a road upon which traffic is likely to converge on the bridge in question. For instance, for surge inundation Point A (Cuckolds Creek Bridge), we assume that Leechville is the start point (19 miles away). We further assume that traffic (i.e. all vehicles (unless otherwise stated) in the area east of Point A) will converge on Point A. (This is unlikely, but it provides a worst case for this study.)

* This factor could double for the eastern-most sections of the county, thereby increasing estimates of total evacuation time shown on page 47.

Exhibit T continued

Assuming storm conditions and evacuation traffic, yet uninterrupted travel, an average operating speed of 35 mph could be maintained on the two-way, two-lane rural roads of the evacuation area. The "free-flow" travel time is, therefore:

$$\begin{aligned}\text{Travel Time} &= \text{Distance/Speed} \\ \text{(Example)} &= 19 \text{ miles}/35 \text{ mph} \\ &= .54 \text{ hours} \\ &= 32 \text{ minutes}\end{aligned}$$

This estimate does not include queuing delay which is determined below.

. Queuing Delay Time

For this study, we assume that practically all of the evacuees on the Northern Shore will originate in Beaufort County, with a few from Hyde County. Evacuees on the Southern Shore are assumed to begin in Pamlico County. 1980 population data will be used to estimate that demand.

In order to estimate the queuing delay time (that is, delay experienced as cars wait in a line to pass a certain point one at a time) during a particular time period of the evacuation, the traffic demand and the bottleneck capacity must be known. For the purposes of this analysis, the following will be assumed:

1. The number of persons evacuating is determined by allocating housing count data from Exhibit P to each surge inundation point along likely evacuation routes.
2. The average automobile occupancy is 2.5 persons per vehicle.
3. 20% of the evacuees leave before the order is given.
4. The remaining 80% of the evacuees leave over a 3.5 hour period.
5. Traffic control officers will be stationed at major intersections thereby mitigating the usual intersection capacity constraints.
6. Intersection turning traffic is negligible compared to the evacuation traffic.
7. Traffic moves at a "level of service D to E."

The evacuation rate or traffic demand is thus,

$$\text{Evacuation Traffic Demand} = (\text{No. of evacuees/Vehicle occupancy}) \times (\% \text{ remaining after order}) \times (1/\text{Evacuation period}).$$

Example:

$$\begin{aligned} \text{ETD} &= (10,000/2.5) (.80) (1/3.5) \\ &= 900 \text{ vehicles/hour (3,200 vehicles in 3.5 hours)} \end{aligned}$$

These vehicles must be accommodated by each surge inundation point which is determined by dividing the 24 hour capacity shown in Exhibit R for NC 264 and NC 92 by 24, and applying the following additional assumptions:

$$\begin{aligned} \text{Ideal Capacity NC 264} &= 10,920 / 24 \text{ hours} = \underline{455 \text{ veh./hr.}} \\ \text{NC 92} &= 7,150 / 24 \text{ hours} = \underline{298 \text{ veh./hr.}} \end{aligned}$$

If it is assumed that storm conditions exist, the bridge capacity will be reduced by fluctuations in traffic demand, wind-blown debris and storm conditions (Appendix B of Sea Grant working paper 83-2). Thus, the capacity calculation for the bridge becomes:

$$\begin{aligned} \text{Evacuation capacity} &= \text{Ideal capacity} \times 0.50 \\ \text{Evacuation capacity} &= 455 \text{ veh./hr. (NC 264)} \times .50 = 222 \\ \text{Evacuation capacity} &= 298 \text{ veh./hr. (NC 92)} \times .50 = 149 \end{aligned}$$

According to Chapter 8 in Reference 19 of Sea Grant working paper 83-2, the maximum amount of individual vehicular delay is given by the following formula:

$$\text{Queuing delay time} = (\text{Duration of bottleneck}) \times (1 - \text{Bottleneck capacity/Average demand})$$

Hence, the following examples:

Queuing delay time:

$$\text{Bridges on NC 264} = (3.5) (1 - 222/900) = 2.64 \text{ hours}$$

$$\text{Bridges on NC 92} = (3.5) (1 - 149/900) = 2.90 \text{ hours}$$

. Total Evacuation Time

Thus, the total evacuation time is the summation of the following components:

Cut-off time	3 hours (given)
Nobilization time	3.5 hours (given)
Travel time	0.5 hours (to be calculated)
Queuing delay time	2 (to be calculated)
<hr/>	
Total (example)	9.0 hours

/4/ Evacuation Time, Preliminary Estimates

Exhibit U presents a summary of the application of the aforementioned methodology as applied to the priority surge inundation points:

Exhibit U

Preliminary Evacuation Time to Selected
Surge Inundation Points

Point	Name	Cut-off time (hrs)	Mobilization Time*	Travel Time	Queuing Delay Time	TOTAL (C + M + T + Q)
A	Cuckolds Creek Bridge	3	3.5	.54	1.9	8.94 hrs.
B	Pantego Creek Bridge	3	3.5	.14	1.15	8.29
E	St. Clair Creek	3	3.5	.46	1.19	8.15
F.	Back Creek Bridge	3	3.5	.67	1.49	8.66
G.	Bath Creek Bridge	3	3.5	.75	1.55	8.80
K.	Campbell's Creek	3	3.5	.69	0	7.19
L.	Wildlife Management Area	3	3.5	.54	0	7.04

*See note on page 44 of this document.

Review of Exhibit U reveals that from 8 to 9 hours of evacuation time is required to get to each surge inundation point on the northern shore while just over 7 hours is required to get to the major points on the southern shore. ADDITIONAL TIME IS REQUIRED TO GET FROM THESE ISOLATED POINTS FURTHER INLAND. THESE ESTIMATES OF EVACUATION TIME ARE MEASURES OF ONLY THE TIMES REQUIRED TO GET TO THESE POINTS, NOT THE TOTAL AMOUNT REQUIRED TO GET TO SAFETY.

In Exhibit U, travel time (T) varies with distance from the surge inundation points, and queuing delay time (Q) varies with population of the evacuation zone and evacuation capacity of NC 264 (222 vehicles per hour) vs. NC 92 and NC 33 (which are both at 149 vehicles per hour).

Sensitivity analysis should be done by changing the values placed on each variable in Exhibit T (such as assuming that 4 or 5 hours cut-off time instead of the 3 shown in Exhibit R). In this manner, assumptions which are closer and closer to reality may be introduced in estimating evacuation time for county residents.

In summary, this analysis shows that much evacuation in Beaufort County, particularly that in the eastern areas of the County both North and South of the River, is approaching the time the National Weather Service is capable of predicting for effectively mobilizing an evacuation effort (12 hours).

This leaves the county with the opportunity to consider adopting policies which would improve the capacity of evacuation routes, or limit the level of development in areas to be evacuated, or otherwise to reduce the amount of time needed to safely evacuate. It is recognized that many factors affecting local evacuation are beyond the control of the local unit of government. Nevertheless, it is vital that the local plan be cognizant of these factors and that regional efforts be initiated to mitigate them.

4. Identifying and Ranking Mitigation Problems.

a. Rationale

The levels of effort devoted to particular hazard mitigation problems should be a function of both the severity of risk and the magnitude of risk present. During the inventories described above, certain issues or problem areas began to stand out from the rest by presenting a high severity of risk and/or a high magnitude of risk. Balancing the severity of risk and magnitude of risk in each hazard area will help the County rank its priorities for hazard mitigation by enabling it to identify the more important problems, address them first, and thus use local resources more effectively and efficiently.

The County should direct a greater level of effort in planning for hazard mitigation to an area with a high severity of risk and a high magnitude of risk (such as a flood hazard area having a large number of structures not designed to withstand hurricane forces such as the area from Washington to Broad Creek). Less effort will be called for in an area exhibiting a lower severity of risk and a lower magnitude of risk (such as part of an A-zone where little development exist or is expected to occur like the area around the mouth of the inter-coastal waterway on the Pungo River). Most of the problem areas in the County will fall between these two extremes. Some areas will have high severity and low magnitude of risk; some areas will have a low severity and high magnitude of risk.

The assessments of risk severity and risk magnitude, and the balancing of the two, culminated in a ranked list of hazard mitigation problem the community

must address. This list of priorities will guide the County in its evaluation of current hazard mitigation measures and its evaluation of other mitigation options which could fulfill those needs not adequately addressed by existing local policies.

b. Methodology

Exhibit V presents the methodology with which the data from the aforementioned analyses were combined. Without providing the complete data here, the following generic grid will illustrate how "planning units" (the cells of Exhibit B) were prioritized to focus attention of the County Commissioners on areas of greater mitigation problems.

Exhibit V

Map Cell Number	RANKING OF RISKS										
	Magnitude of Risk						Severity of Risk				
	Inventory of Real Estate Value	Land Use Trend (Land Class)	Inventory of Structures				Erosion Shoreline Type	Flood Z in Wave	area	Wind	Priority (yes/no)
	A	B	# Res. C	# Comm. & Ind. D	# insts. & utils. E	Evac. F	G	H	I	J	K
North Shore											
22											
23											
31											
32											
41											
34											
49											
50											
42											
44											
51											
43											
35											
36											
27											
28											
29											
19											
20											
13											
South Shore											
31											
40											
41											
48											
56											
62											
67											
57											
63											
58											
64											

Footnotes for Exhibit V.

Column A. Real Estate Value comes from worksheets of detailed data that were compiled for preparation of Exhibits N and O.

Column B. Trend means the planned land classification for future development presented in the Beaufort County Land Use Plan. A scoring system was devised which assigned points to each land class. The percentage of each map cell in a particular class was multiplied by the points on that class and summed to get a cell score. For instance, the Developed Class was assigned 21 points; Transition, 18; Secondary Transition, 15; Community, 12; Rural, 9; and Conservation, 6. Map cell number 31 consists of 70% Developed, 10% Secondary Transition, and 20% Conservation. Thus, to determine the trend score for cell 31, multiply $.70 \times 21$ points + $.10 \times 15$ points + $.20 \times 6$ points, for a total of 17.4 points. This total is then compared with similar scores in all other cells to determine the priority cells under the trend (or future growth area) column.

Column C, D, E are the raw data from Exhibit N and O, recombined into the categories presented here.

Column F was not actually used, but could receive a scoring system to rank cells by the number of miles of routes under the flood level, or some other measure of constraint on evacuability (such as known bottlenecks, etc.)

Column G. This column received points in each cell if the cell contained one of the highly erodible land forms presented in Exhibits H, I, or J. Simply, 3 points each were assigned to a cell if it had low banks, marsh, or High Banks as presented in the East Carolina University Chart discussed above. For example, cell 31 has all three forms, so it receives 9 points.

Column H (Wave Action) was assigned a nominal score of high, medium, or low if the area was susceptible to wave action.

Column I contains a percentage score indicating the amount of the cell in the hazard area (the % of the cell covered by the A zone).

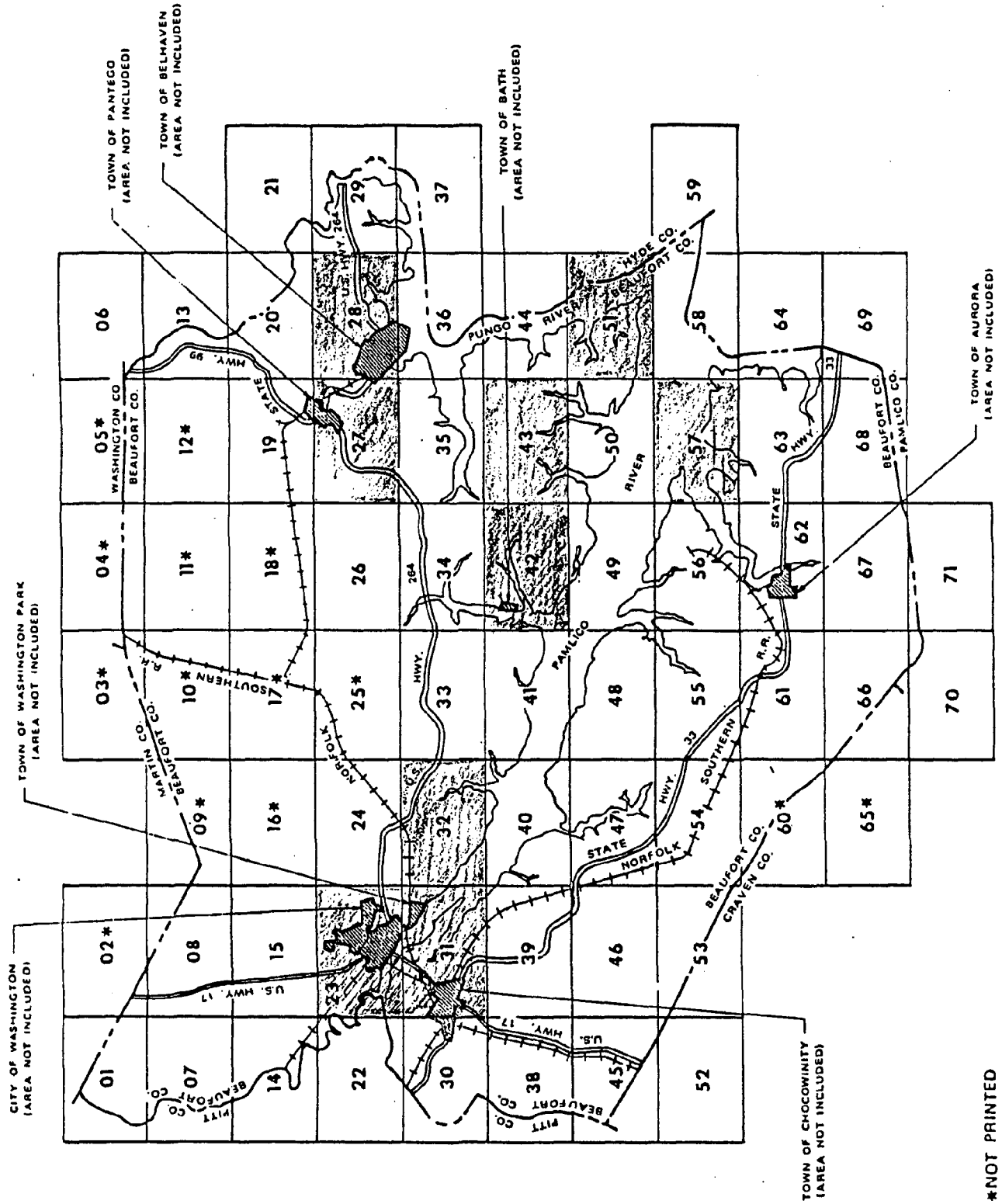
Column J was included to point out that every cell is equally susceptible to high winds.

Column K was determined by "eyeballing" across each of the columns and making a judgement about the relative position of cells. The top 9 most heavily scored cells were selected for focus, 9 because of the limits of the budget and requirements of attention to post disaster reconstruction and evacuation planning pending.

c. Findings

Exhibit W presents priority areas selected from Exhibit V. It is upon these areas that the remainder of the mitigation analysis and planning will concentrate (i.e., reviewing current mitigation measures, reviewing alternative measures, and selection of implementation and monitoring measures).

Priority Mitigation Areas (shaded cells)



*NOT PRINTED

5. Reviewing Current Mitigation Measures

Having identified Beaufort County's major hurricane hazards of erosion, wave action, flooding and wind damage, related these to the magnitude of risk on the landscape and identified the nine (9) priority areas, and estimated evacuation time, the planning effort turns toward reviewing current policies and programs which purport to reduce the risk of future damages. This review is intended to give the Commissioners a clearer understanding of any conflicts in policy within the local government and between the local government and state and federal agencies.

It is also intended to identify whether or not local government efforts at managing the location and quality of development are adequately addressing the specific mitigation needs list identified previously.

a. Inventory of Policies

The various local, state, and federal policies and programs related to hurricane mitigation are identified from the Beaufort County Land Use Plan Update, CAMA, Revised September 16, 1981, pages I-20 thru I-28.

The Land Use Plan itself

Community Facilities Plan, 1979

Capital Improvements Program, 1979

Hurricane and Flood Evacuation, 1979

Water System Plan, 1977

Sanitary Sewer (201 Plan)

Building Code

Septic Tank Regulations

Flood Insurance

Mobile Home and Travel Trailer Ordinance

CAMA Implementation and Enforcement

Recreation Policy

Utility Extensions

Transportation Improvement Program, 1980-1986.

Also from the CAMA Land Use Plan is the following selection of State and Federal regulations which are most closely related to storm mitigation in Beaufort County (see Land Use Plan, pages I-29 thru I-32).

State: .Permits for septic tanks with a capacity over 3000 gallons/day.

.Permits for construction of complexes, e.g. parking lots, subdivisions, stadiums, etc.

.Permits to dredge and/or fill in estuarine waters, tidelands, etc.

.Permits to undertake development in Areas of Environmental Concern.

.Sedimentation erosion control plans for any land disturbing activity of over one contiguous acre.

.Easements to fill where lands are proposed to be raised above the normal high water mark of navigable waters by filling.

.Approval for construction of any public water supply facility that furnishes water to ten or more residences.

Federal: .Permits required under Sections 9 and 10 of the Rivers and Harbors Act of 1899; permits to construct in navigable waters.

.Permits required under Section 202 of the Federal Water Pollution Control Act of 1972; permits to undertake dredging and/or filling activities.

.Permits for bridges, causeways, pipelines over navigable waters; required under the General Bridge Act of 1946 and the Rivers and Harbors Act of 1899.

(b) Analysis of Policies

Having identified pertinent policies, the next step is to analyze the extent to which they are directed at reducing the risks of hurricane damage in Beaufort County.

Before the Storm recommends a framework for analyzing the potential effectiveness of existing policies. It offers two criteria which we apply to the overall list of Beaufort County policies mentioned above:

Criteria 1: Coverage: Problems in coverage arise when local policy fails to account for a particular characteristic of development, or a particular hurricane force (wind, waves, etc.), which increases development risk of future hurricane damages.

Criteria 2: Enforcement: Problems in enforcement arise when local policy adequately covers a particular characteristic of development but, for some reason, is not carried out in the local government's day-to-day decisions and operations.

From the foregoing analysis of magnitude and severity of risks for hurricane damage, we examine the aforementioned policies to determine whether, in general terms, there are coverage problems, and enforcement problems related to the following factors, (located primarily in cells 23,31, 32, 27, 28, 42, 43, 51, and 57 of Exhibit V).

Magnitude of risk in the Hurricane Hazard Area:

- Real Estate Value (existing development)
- Trends in Development (future real estate value)
- Inventory of structures (count)
- Evacuability

Severity of Risks in the Hurricane Hazard Area:

- Erosion of Shoreline (by type of shoreline land form)
- Susceptibility from wave action
- Flood proneness
- Wind susceptibility

To assist in grasping the idea of coverage and enforcement problems related to these factors, Before the Storm presents Table 5.1 (herein referred to as Exhibit X) for our reflection.

Exhibit X has been modified to become an answer sheet which helps us begin to identify problems toward which to direct alternative policies and policy selection.

Exhibit X

Checklist for Reviewing Current Mitigation Measures

Beaufort
Co. status

For development throughout the community:

- Do existing policies and regulations recognize the existence of different hazard areas that are subject to different forces? yes
- Do they cover all types of structures (single-family, multi-family, commercial, etc.)? yes
- Do they cover public facilities as well as private? yes
- Do they encourage higher-density uses to locate outside of the most hazardous areas? no/yes
- Are non-conforming uses and structures to be brought into conformity after they are damaged? no
- Do existing policies and regulations related the level of development in the community to the capacity of existing evacuation routes and the time it would take to evacuate the community? no

For areas subject to high winds (Area 4):

- Do existing policies and regulations require structural connections and bracing adequate to withstand hurricane-force winds (or "annual extreme fastest wind speeds")? no
- Do they require mobile homes to be tied down? yes

For areas also subject to flooding (Area 1):

- Do existing policies and regulations require buildings and utilities to be elevated or floodproofed to or above expected flood levels? no
- Do they require structural connections which withstand the flotation and lateral movement of structures? no

For areas also subject to wave action (Area 3):

- Do existing policies and regulations require buildings to be elevated to or above the expected wave height? no
- Do they require structural connections and bracing adequate for the building to withstand battering by waves? no
- Do the regulations prohibit building on fill which could easily be washed away? no

For areas also subject to severe erosion (Area 2):

- Do existing policies and regulations require an adequate setback from the oceanfront or soundfront? no
- Do they require a safe depth for embedding pilings? yes
- Do they prohibit the removal of sand dunes and other natural barriers to erosion? yes

SOURCE: Before the Storm, Table 5-1, page 5.16

6. Reviewing Alternative Measures

a. Philosophy Behind Alternatives

A coverage issue is found on page 2-4 of the Land Use Plan with regard to the County's basic position on the issuance of permits for minor development within the AECs.

By so choosing, it agreed that the uses permitted under state administrative regulations were necessary and represented the best available information. No information has since become available to the county which would allow it to argue effectively for a less restrictive set of uses. Nor has any information come to the county which make apparent the need for a higher level of protection than offered by existing regulations. Therefore, it is the county's intent to continue to guide the development of AECs in accordance with existing regulations.

After discussing the underlined sentence above, and in light of the information regarding the magnitude and severity of risk of hurricane damage provided in Section II, Part 3, A2, A3 and A4 of this document, the County considered the following set of policy choices from which to reconsider (1) maintaining the existing philosophy outlined above, or (2) taking advantage of the opportunities to protect its tax base and tax payers.

b. Range of Policy Options.

As recommended in Before the Storm, "to overcome the shortcomings in coverage or enforcement of existing policies, a community should review other techniques that could be used effectively and efficiently to reduce the risk of future hurricane damages. Different techniques are suited to different development and redevelopment problems; certain techniques will be more practical and more effective than others in addressing the community's particular hazard mitigation needs" (BTS, page 5.19).

Consistent with this analytical approach, the following list of choices among policies and measures is presented. It is from this list and others generated by consideration of it, that the selection of workable hazard reduction measures is to be selected.

- (1) Objective: To maintain or strengthen existing policies known to decrease the risk of hurricane damage.

- . The County now administers parts of the state building code with an inspections program. This program has recently expanded attention into construction standards for footings, framing, plumbing (including well and septic), and insulation, as well as electrical.

The commissioners could choose to adopt the complete state building code and administer it county-wide, so as to upgrade the quality of construction and the extent to which it is hurricane worthy.

- . The construction standards of the Federal Emergency Management Agency are required for areas that are participating in the regular phase of the flood insurance program. Only Washington, Washington Park, Belhaven and Aurora are participating in the regular phase, with the remainder of the unincorporated county, Pantego, Bath, and Chocowinity participating in the emergency phase.

The option facing the commissioners is one of using the best available 100 year flood level from the emergency phase (10 ft.) and requiring the elevation of the first floor of buildings in the hurricane hazard area (Exhibit (D)) now, with refinement after the regular phase is official.

- . The state's Sedimentation Control Act (15 NCAC 04A) requires an erosion and sedimentation control plan to be prepared and filed with the Environmental Management Commission or the County Commissioners prior to the commencement of any land disturbing activity of more than one acre.

This policy allows two important types of development to go untended in the flood hazard area, agriculture and small lot residential development.

The commissioners have the choice of (1) decreasing the land area to one-half acre, thereby locally requiring residential development on waterfront lots (of at least this size) to take adequate precautions against erosion, and (2) including agriculture and forestry as land uses that in fact cause "a change in the natural cover or topography that may cause or contribute to sedimentation".

- . CAMA includes a buffer of 75 feet in the Estaurine Shoreline AEC (15 NCAC 7H, 0209 (b) and (d) in which developed is monitored and regulated in terms of siting. Some types of development may be prohibited depending on the specific site carrying capabilities.

Since the tightening of these standards could be beyond the administrative capacity of the county, the choice facing the commissioners is likely one of changing the "buffer" provision to a "setback" provision, which would require that uses which could otherwise be built more than 75 feet from the shoreline must be; otherwise the regulations of CAMA would operate as now written.

(2) Objective: To create policies which REDUCE risk.

- . As indicated in the 1982 CAMA Land Use Plan, the commissioners have no subdivision regulations which govern the design of developments or the quality of construction of roads in subdivisions. Subdivision of land is traditionally regulated because it transforms large acreages from a rural character to a suburban/urban one.

The county commissioners have an option to adopt subdivision regulations (without zoning). Into these, provisions of floodplain management, adequate lot size, and drainage could be written. These regulations would require plats which show the first floor elevated above the best information available regarding the 100 year flood.

- . The County has a detailed soils analysis underway through the District SCS (Mr. E. H. Karnowski's office). This information could be used to develop soils overlay districts within which to set density standards based upon soil characteristics and their carrying capacities in terms of abilities to accept septic effluent, and load bearing capabilities to bear development (see Exhibits G, H, I, and J).
- . Since natural solutions are often the best, the commissioners could consider establishing a vegetation or landscaping ordinance for shorefront property that requires careful development, recognizing the value of retaining vegetation, retaining trees as a buffer on the shoreline between the wind and water of a storm and buildings. This would include retaining the wind-clipped trees closest to the water, which protect the rest of the shorefront lot (Caring for the Land, Environmental Principles for

Site Design and Review, by Bruce Hendler, ASPO, 1977, #328, page 24.)

while still allowing undergrowth trimming as long as the major shorefront
stabilizing vegetables remained.

. Since much of the area within the hazard area (Exhibit E) is in agricultural use, the commissioners could establish an Exclusive Farm Use Zone in a Development Options Ordinance. This approach was used as part of the Land Resource Management Program, Oregon State University Extension Service. It guarantees continued agricultural uses and also contains and restricts urban uses in areas which are high in erosion and which have low tolerance for high densities and impervious surfaces, and which otherwise have sensitive environments.

. Since the taxation of land is a fundamental influence in development patterns, the Commissioners could implement one of the 1982-83 objectives of the North Carolina Association of Soil and Water Conservation Districts Land Use Planning Committee. The Association recommended that plans, such as this Storm Mitigation Plan should make provisions for consideration of equitable assessments of land use for agricultural, wildlife, recreational aesthetic, or other uses which are significant (hurricane risk reducing) interest and importance to the general public. (Source: NC Association, Soil and Water Conservation Districts, Raleigh, NC, June, 1982, page 7).

Taxation could be strategically designed to guide development away from hurricane risk areas (or perhaps, the higher risk areas within the flood zone), by placing a "hazards premium" on development placed in areas of excessive risk, or conversely, allowing a preferential assessment ("hazard-avoidance discount") on property back away from the shoreline or otherwise outside areas of extreme risk. This could minimize present and future unnecessary public expenses to serve such areas (e.g. fire and sheriff services) and also prevent unnecessary public expenses to "clean up

the mess" following a major storm. While not exactly transferable, the recent March 1984 tornado disasters in neighboring counties emphasize the public costs involved in clean up and reconstruction.

- . The Commissioners could consider establishing an erosion and runoff ordinance for only the most sensitive areas. This would involve the development of a drainage overlay district which would locate critical drainage channels, particularly those which often become overwashed and inundated during moderate storms. (Such areas are known as "weak spots", and are a type of hurricane risk hazard included in the county's hazard area (Exhibit (D))).

This overlay district would assist in the preservation and protection of the natural environment by: regulating the alteration of land and topography; regulating the removal of vegetation; specifying standards for drainage system construction; requiring erosion and sedimentation control; assuring the continued, efficient operation of the drainage system; (and) protecting county streams and floodplains from substantial alteration of their natural functions. (Source: Thurow et al., p. 104.)

. Since the County has traditionally resisted county-wide land use zoning in any form, the commissioners may consider: (1) developing a flood hazard area ordinance which would incorporate many of the aforementioned provisions that could otherwise be put into separate ordinances or (2) zoning a smaller portion of the county where development is intense but subject to no guiding influence. This targeted approach directed at the priority risk areas in the County could become the foundation piece of a thoughtful way of supportively directing development without stifling it. In many cases, developers are more likely to bring their investments to a county which offers them proper protection through ordinances. A selective zoning ordinance could indicate that the commissioners are working to protect whoever's investment goes into the hazard hurricane hazard area, and is doing all it can to lessen the costs to developers, the federal insurance agency, and most importantly, the tax payers for they foot the bill to "clean up the mess."

- (3) Objective: To amend or avoid actions known to increase risks.

Exhibit Y indicates that there is clear responsibility taken in 1972 by the County Commissioners to "adopt and maintain in force for areas having special flood hazards, adequate land use and control measures..." This storm mitigation, Post Reconstruction and Evacuation Plan is an additional step in that direction.

Avoiding actions known to increase risks is an objective the Commissioners can address through education of the public about the risks of locating in the hazard area. It is the intention of the Commissioners to provide that information through this planning effort and its Office of Emergency Management.

NORTH CAROLINA - BEAUFORT COUNTY

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On motion by M. D. Whisnant, seconded by Calvin Pittman the following resolution was unanimously adopted:

RESOLUTION

The County of Beaufort in applying for Federal Flood Insurance by Resolution dated November 1, 1971, does agree to adopt and maintain in force for areas having special flood hazards, adequate land use and control measures with effective enforcement provisions consistent with the criteria set forth in Part 1910 of the Department of Housing and Urban Development, Federal Flood Insurance regulations.

That the County of Beaufort shall recognize and duly evaluate flood hazards in all official actions relative to land use in the areas having special flood hazards and to take such other official action as may be reasonably necessary to carry out the objectives of the program.

That the County of Beaufort shall assist the Administrator, at his request, in delineating the limits of the areas having special flood hazards on available local maps of sufficient scale to identify the location of building sites.

That the County of Beaufort shall provide such information as the Administrator may request concerning present uses and occupancy of the flood plain area.

That the County of Beaufort shall maintain for public inspection and furnish upon request, with respect to each area having special flood hazards, information on elevations in relation to mean sea level of the lower floors of all new or substantially improved structures and, where there is a basement, the distance between the first floor and the bottom of the lowest opening where water flowing on the ground will enter.

That the foregoing Resolution is passed pursuant to request from the Federal Insurance Administration of the Department of Housing and Urban Development for purposes of designating the County of Beaufort as being eligible for Federal Flood Insurance.

This the 4th day of January, 1972.

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TOM, N. C.

7. Implementation and Monitoring

a. Rationale

At this point in the hurricane planning process, Beaufort County has several products. First is a list of hurricane hazard mitigation needs or development characteristics the community needs to control. Second is a compilation of measures which are currently in place to mitigate the hurricane hazard. Third is a compilation of measures which the community can adopt to cover any needs that current measures fail to address. The next step in the process involves blending these into a coordinated local program for reducing the risk of hurricane damages.

Implementation of local policies is the final step in formulating a hazard mitigation program, as it is with any good planning effort. But beyond that work and after local policies are implemented and hazard reduction measures are being carried out, the County will need to monitor development to ensure that prescribed measures are being followed.

In this case, implementation involves adopting policies and ordinances selected by The Board of County Commissioners as necessary to put hazard mitigation measures into effect.

Some of the policy choices would put hazard mitigation measures into continuous operation as a means of managing development in the community, such as subdivision requirements or construction standards. Other policies would put hazard mitigation measures into effect only in response to disaster, such as relocation programs and temporary moratoria on development

and reconstruction. All policies which guide development and reconstruction recognize the different levels of risk that exist in different parts of the county and in different types of structures.

b. Selected Policies and Measures.

1. Continue to enforce the State building code.
2. Adopt the regular phase of the FEMA flood insurance program at the appropriate time (when the final mapping is completed).
3. Conduct a risk-avoidance education program through the Office of Emergency Management to advise current and prospective developers and buyers of the hurricane risks in Beaufort County.
4. Establish a procedure in the Inspections Department of determining, at the time that building permits are requested, whether the permit is for construction within the Hurricane Hazard Area shown in Exhibit E. If so, advise the applicant of the potential hurricane hazards, discuss recommended construction techniques for such areas, and suggest that he contact the Federal Emergency Management Agency (through local financial institutions providing construction loans) for information on reduced insurance premiums under the FEMA program for construction with the first floor above the 100 year flood (10 feet).

c. Monitoring Consistency and Effectiveness Over Time

It is the intent of the County Commissioners that local hurricane hazard mitigation be integrated with other local plans, policies, and programs which cover other aspects of development in the county.

Through the Office of the Emergency Management Coordinator, the County will continuously observe how development is proceeding in the community once these hazard mitigation measures are adopted and implemented. Keeping track of development will help the County see if hazard mitigation policies are being followed and if hazard mitigation policies need to be modified in any way to make them more workable and effective. Such monitoring can identify further problems in coverage and enforcement that need to be resolved. Such monitoring efforts may involve less formal, continuous observations or more formal, periodic evaluations. In these forms, monitoring efforts will pay attention to where development is locating (relative to different hazard areas) and how development is being built (relative to the forces expected in each hazard area).

With the recent March, 1984 tornado disasters in neighboring counties, the county should be highly alerted as to possible and pending damage when a hurricane strikes. An areawide assessment of the "institutional ability" of local government to deal with these natural disasters might be made.

B. Post Disaster Reconstruction Plan

1. Introduction

Before the Storm (Chapter 7) outlines the optimal process and elements of a post disaster reconstruction plan as follows:

As an official statement of principles and policies for the community to follow in rebuilding after a hurricane or similar disaster, a reconstruction plan has four purposes:

1. to expedite community recovery by outlining procedures and requirements for repairs and reconstruction before damages occur;
2. to establish a procedural framework for putting hazard mitigation measures into effect after disaster strikes the community and buildings and utilities are being repaired and rebuilt;
3. to gather and analyze information concerning the location and nature of hurricane damages in the community; and
4. to assess the community's vulnerability to hurricane damages and guide reconstruction to minimize this vulnerability.

The plan should outline damage assessment and reconstruction permitting procedures that the community will follow after a disaster occurs. It should identify information that the local government will need to make sound permit decisions regarding repairs and reconstruction and to get state and federal disaster assistance. Some specific topics that the plan should address include:

1. identifying cases where repairs and reconstruction will not be permitted, or will be permitted only if they meet certain conditions;
2. guidelines (drawn from the analysis of hazards and mitigation measures) for the repair and rebuilding of damaged structures and utilities; and
3. plans for possible public acquisition of high hazard areas and the relocation of highly vulnerable and damaged structures.

By identifying and clarifying all of these policies, procedures, and information requirements, local officials will have a ready set of guidelines by which they can make wise and expedient decisions regarding reconstruction. The plan will help avoid delays as well as make the community safer from damages in the long run.

Since the bulk of the effort on this initial plan has been directed at Storm Mitigation, the following initial Post Reconstruction Plan relies heavily upon the Beaufort County Disaster Relief and Assistance Plan adopted in September, 1982.

Sections of that plan which pertain most to Post Disaster Reconstruction are Annex F (Beaufort County Damage Assessment Plan); Annex G (Disaster Assistance Center Plan); Annex H (Disaster Assistance Program Summary); and Annex I (Beaufort County Plan for Temporary Housing).

While attention is given to the optimal reconstruction planning guidance of Before the Storm, close attention is given to the CAMA Regulations 15 NCAC 7B .0203 (a) (6) (B) and is presented in the outline form of the latter.

2. Elements of Preparedness

a. Local Damage Classification Scheme and Damage Assessment Teams.

The aforementioned regulations require (1) the establishment of a local damage classification scheme which is consistent with those of state and federal disaster assistance agencies. Before the Storm additionally suggests that (2) these procedures should be designed to indicate, according to local hazard mitigation policies, which structures may be repaired or rebuilt with no changes, may be repaired or rebuilt with structural changes, or may not be rebuilt at the same site.

From review of Annex F of the Beaufort County Disaster Relief and Assistance Plan, and intense work sessions with the County's Emergency Management Coordinator (Mr. Daden Wolfe) and the former DEM Area Director (Col. David W. Spivy), it was determined that the county has adequate damage assessment procedures regarding purpose, authority, organization, concept of operation, articulation of responsibilities (including designation of Damage Assessment Teams), and setting forth instructions for timely action and phased reporting (that is, the detail of the reports increases with time after a disaster).

The document provides detailed appendices to Annex F regarding the identification of team damage assessment worksheet; damage estimation guides which records extent of habitability, based on percentage of damage; damage assessment property values and estimate percentage of insurance coverage by type of property and values (note: this form was used in the survey of structures for the storm mitigation plan, first portion of this document); and provides extensive damage assessment report forms.

b. Permit Procedures

On this point, Before the Storm uses an approach typically found in zoning ordinances for dealing with damaged structures or situations which do not conform to the ordinance. If the Commissioners do adopt such regulatory ordinances, then the following suggested additional steps could be carried out by the standing damage assessment teams.

- . identify those structures that must be demolished or that require a development permit before being repaired or rebuilt;
- . identify, for each damaged structure, the cause of damages; and
- . identify repairs needed for individual private and public facilities.

"This information can be translated onto property tax maps to readily identify those areas where repairs and reconstruction must meet certain requirements. When the damage assessment is completed, the damage assessment team could fill out a form identifying the level of damages sustained, or damage classification, of each property and any special requirements for repairs and reconstruction; the form could then be mailed or otherwise delivered to the property owner. The form could include any other information the property owner should know regarding recovery procedures (such as permit requirements, filing deadlines, and public meeting dates)." (Before the Storm, p. 7.31, 7.32)

Building permits for whichever level of reconstruction would be let under the County's normal permit issuing procedures. Efforts to streamline the handling of large numbers of permits will be undertaken in accordance with Before the Storm (page 7.32). Several of the suggestions presented there are incorporated in this initial plan as follows:

- . repair and rebuild essential service facilities first (such as electricity, water and sewer).
- . repair other public facilities as necessary for shelter, etc.

- . use a triage (or worst damage last) approach to staging the reconstruction effort. Those properties with little damage would be permitted immediately, if they complied with permit requirements already. Next, those with moderate damage, meeting permit requirements. Followed by those with moderate damage, requiring permit decisions. Those with extensive damage requiring permit decisions or demolition decisions would receive treatment last, since their work would more likely interfere with the reconstruction of essential public utilities and facilities.
- . be prepared to adopt a temporary moratorium on all new development for a specified period of time. This would allow the county to deal with more pressing community recovery and reconstruction permitting problems without devoting its resources to reviewing new development proposals.

These initial priorities are provided in this document to set forth a beginning point for reconstruction efforts. They will necessarily be refined over time through the Office of Emergency Management.

Future efforts should emphasize Emergency Management responsibilities for immediate clean up and removal activities to minimize health and safety hazards and the County should develop local policies which will direct reconstruction over a longer period of time.

c. Consideration of a "Recovery Task Force"

The County Commissioners considered appointing a "recovery task force" to oversee the reconstruction process and work on any policy questions that might arise. The recovery task force will work with state and federal representatives on the Interagency Regional Hazard Mitigation Team and the Section 406 Hazard Mitigation Survey and Planning Teams. Like these joint federal/state/local teams, the task force can review the nature of damages in the community, identify and evaluate alternative approaches for repairs and reconstruction, and formulate their own recommendations for handling community recovery. The task force's efforts can lend valuable information and guidance to state and federal efforts and ensure a strong local voice in decisions regarding state and federal disaster assistance.

Formerly appointed in advance of a disaster (as of this writing), the initial recovery task force will comprise the following individuals:

- the Beaufort County Commissioners
- the County Engineer and Building Inspectors
- the County Manager
- the City Managers and Engineers of each Municipality
- the County Emergency Management Coordinator
- the County Health Department

The task force could be given any number of duties which are to be worked out in the future. However, the authority to approve or deny permits for repairs and reconstruction remains with the group that normally handles development decisions (that is, the local commission, planning board, or board of adjustments).

d. Guidelines for Post-Disaster Repair and Reconstruction.

(1) Timing and completion of damage assessments.

As indicated above, these will be conducted in accordance with Annex F of the Disaster Relief and Assistance Program and will be completed in a phased manner (general reports first, detailed as time permits) as soon as safety conditions permit. Rapid and general reports are to be submitted by radio regarding immediate problems, within one hour after the assessment begins. This provides a windshield survey or snapshot of the extent of damage. Within six hours more detailed reports, including private property summaries will be near completion (see Annex F).

(2) Temporary Moratoria.

As indicated above, the Commissioners are prepared to adopt a temporary moratorium on new development if conditions warrant such, especially if it is required to assure the reconstruction of essential public services. The intent is any such moratorium is to stage reconstruction activities and to ensure that repairs and reconstruction will leave the community safer from the next storm. The Commissioners may declare such a moratorium on any development if the County gets a federal disaster declaration stipulating the type and extent of reconstruction that the federal insurance agency will pay for.

(3) Development standards.

The development standards to which repairs and reconstruction shall conform include those presented in the Policy Statements section of the Storm Mitigation Plan section of this document. At present, these include the major portions of the State Building code and any other policy provisions adopted in the Storm Mitigation Plan.

e. Schedule for Staging and Permitting Repairs and Reconstruction.

As indicated by the former DEM Area A Coordinator, reconstruction would be undertaken for essential services first (that is, power, water, telephone, street and bridges), then minor repairs, major repairs and last, new development. (See part 2, this section). Emphasis then, is on following schedules (policies) which require repair reconstruction of infrastructure for the long-run, rather than immediately going back into an area and duplicating what was there before the storm.

Timing of actual event depends upon the extent of damage and the type of service requiring repair or rebuilding.

f. Implementation of Recovery Task Force Policies

The Beaufort County Commissioners are hereby designated as the local legislative body in charge of implementing the policies and procedures contained in this Post-Disaster Reconstruction Plan.

g. Policies for Repair and/or Replacement of Public Utilities and Facilities.

The policies for replacement of these facilities, including possible relocation to less hazardous areas, are outlined in the ordinances or other measures adopted as part of the Storm Mitigation Plan (this document).

Additionally, such facilities are placed in priority within this section, depending on their importance, type, and state of disrepair. (See sections 2 and 5).

C. Local Evacuation Plan

1. Introduction

a. CAMA Regulations and Requirements

The CAMA regulations for Storm Hazard Mitigation, Post-Disaster Recovery and Evacuation Plans (15 NCAC 7B .0203(a)(6)(C) set forth the following requirements:

The local government shall, in cooperation with the Division of Emergency Management, assure that the local evacuation plan is adequate and based on a sound analysis of existing situations. In particular, the local government should consider all natural and man-made impediments to evacuation such as roadways below expected flood level, development which exceeds road capacity and reliance of other communities on the same evacuation route. If the local government determines that the required evacuation time exceeds the standard warning time as provided by the National Weather Service, it should consider adopting policies which would improve the capacity of evacuation routes, or limit the level of development in areas to be evacuated, or otherwise reduce the amount of time needed to safely evacuate.

It is recognized that many factors affecting local evacuation are beyond the control of the local unit of government. Nevertheless it is vital that the local plan be cognizant of these factors and that regional efforts be initiated to mitigate them.

Appropriately, in Part (D), these regulations require the presentation of the Storm Mitigation Plan before the presentation of the Post Disaster Reconstruction Plan, before the Hurricane Evacuation Section. This, plus other explicit guidance and logic of the planning process equipped the Beaufort County Commissioners to meet the analytical requirement for consideration of the natural and man-made impediments to evacuate enumerated above.

Thus, in this section, the County has chosen to meet the aforementioned regulations and their purpose of adequate evacuation through referencing the Storm Mitigation Plan and the Post Disaster Reconstruction Plan for foundation analytical and policy work, and to provide update to the County's 1982 Disaster Relief and Assistance Plan (particularly Annex O) as needed.

b. Beaufort County's Response

For meeting this section of the CAMA regulations and satisfying their intent of adequate evacuation preparedness, the "local evacuation plan" shall mean the portions of the Beaufort County Disaster Relief and Assistance Plan (September, 1982) which pertain most closely to the task at hand. These include, but are not limited to:

Annex A Emergency Powers Ordinance

Annex B Organization Chart

Annex C Communications

Annex D Warning and Alerting

Annex E Beaufort County Emergency Shelter Plan

Annex O The Hurricane Plan

Annex U Emergency Broadcast System Plan

Each of these Annexes was examined for completeness, relationship with the CAMA regulations, and consistency with the guidelines for the "Carolina County Emergency Management Hurricane Response Plan Prototype" and the guidelines for the "Carolina County Disaster Relief and Assistance Plan, Annex O - Hurricane Response Plan" (provided by the State Civil Defense Office). Worksessions with the County Emergency Management Coordinator

(Daden Wolfe), the former Area A Coordinator (Col. David W. Spivy) and the planning chief for the State Civil Defense Office (Bob Buchanan), can assure the citizens of Beaufort County that the aforementioned Annexes are adequate and based upon sound analysis of existing situations.

The remainder of this section presents work done to supplement Annex 0 as evidence of this assertion of adequacy.

2. The Natural and Man-Made Impediments to Evacuation

a. Description and Reference to Other Plans.

In this section, several natural and man-made impediments to evacuation which have already been analyzed in the Storm Mitigation Plan and the Disaster Relief and Assistance Plan are discussed. The reader is referred particularly to sections A2 and A3 of the Storm Mitigation Plan (this document) and to Annex O of the Disaster Relief and Assistance Plan for analyses and findings from those perspectives.

b. Analysis of Major Evacuation Routes

The following section considers the major routes in the following format:

- . Areas below flood level.
- . Surge Inundation Points.
- . Extent of Impediment to Evacuation
- . Reliance by Other Communities
- . Estimated Evacuation Time (see Storm Mitigation Plan, part II, 3, 6, 3 /4/)
- . Policy Choices

(1) Highway 264 from Hyde County Line to Washington

- (a) Areas below flood level: See Exhibit E
- (b) Surge Inundation Points: See Exhibit S
- (c) Extent of Impediment to Evacuation:

NC 264 floods in the entire Belhaven Area, and between Belhaven and Pantego, even from the rains of a moderate storm. Water rises above the approaches to the Cuckolds Creek Bridge (point A on Exhibits P and S) preventing the use of the bridge. According to local DEM Officials, the bridge itself is of adequate height. The water source is from the Pungo River and Pamlico Sound waters backing up because of storm winds.

People from Manteo will use NC 64; however, evacuees from Stumpy Point and south will use NC 264 through Hyde County into Beaufort at Leechville. If Belhaven is flooded, people in Belhaven or from Leechville can take SR 1709 and turn north to SR 1700 and go west to Pantego, though 1709 is unpaved (and should be improved as an evacuation route). Or they may choose to go north on Highway 45 to a point 5 miles south of Plymouth, and there may choose to go into Plymouth and turn south 31 miles to Washington, depending on storm conditions.

Another critical surge inundation point (point I on Exhibits P and S) is at the Runyan Creek Bridge. Although Runyan Creek is only about 12 feet wide, the bridge is in a bottom area which floods easily. In the event of such flooding, evacuation would have to be accommodated by turning at Sherwood Forest community onto the old Bath Highway (1501), traveling to 1507, and turning north onto 1516 to Cherry Road, and then to Washington, bypassing the bridge.

- (d) Reliance by Other Communities: High Reliance, see (3) above.
- (e) Estimated Evacuation Time. (See Storm Mitigation Plan, Part II, 3, 6, 3 /4/.)
- (f) Policy Choices:
 - . Regarding NC 264, choices include elevating the bridges, earlier warnings, better cooperation with the officials in Belhaven regarding the reality of their floodproneness.
 - . Capacity of route 264 is adequate except at "pre-landfall time" when surge inundation points A and I are flooded.
 - . SR 1709 should be improved, if not paved, in order to provide an evacuation route from 264 to SR 1700, so that flooded Belhaven can be avoided or evacuated.

- . Other solution rests in early warning and cooperative evacuation.

(2) Highway 92 from Belhaven to Bath

- (a) Areas below flood level: See Exhibit E
- (b) Surge Inundation Points: See Exhibit S
- (c) Extent of Impediment to Evacuation:

- . In Belhaven, when the water crests the railroad tracks, Highway 92 is impassible for evacuation of the town.
- . This means that the Pantego Creek bridge (or approach to it is flooded, as is the Pungo Creek Bridge access, and an area approximately 3 miles on either side of where the road to the Ferry is (SR 176).
- . There is concern at Back Creek and Bath Creek bridges, even though Bath itself is largely above the flood elevation. In the event that Back Creek floods, evacuation is possible on 1743 (Possum Hill Road), which can bring traffic into the Bath High School Shelter. This northerly approach provides access without the use of either bridge.

. If the storm is severe enough to warrant
by-passing the Bath High School shelter,
traffic can take SR 1741 to NC 264 and turn
left into Washington.

(d) Reliance by Other Communities:

None. Residents of Hyde County would use NC 264,
not Highway 92.

(e) Estimates Evacuation Time. (See Storm Mitiga-
tion Plan, Part II, 3, 6, 3 /4/.)

(f) Policy Choices:

According to the road capacity analysis in the Storm Mitigation Plan, the capacity of Highway 92 is adequate, limited only by the surge inundation points.

The level of development on Highway 92 is not an impediment, except in the towns.

Strategy for reducing evacuation time is to (1) alert people as soon as possible; (2) educate them to the need to believe the announcement and promptly begin evacuation.

(3) SR 1300 from Washington Yacht and Country Club
to the Runyans Creek Bridge.

- (a) Area below flood level: See Exhibit E.
- (b) Surge Inundation Points: See Exhibits P and S
- (c) Extent of Impediment on Evacuation:

Major area of concern is from Washington Yacht
and Country Club to the Runyans Creek Bridge at
the Washington City limit (point F on Exhibits P
and S).

If this is flooded, all the area riverside of SR
1300 will have no way to evacuate.

- (d) Reliance by Other Communities:

None, though this is itself a heavily populated
area.

(e) Estimated Evacuation Time. (See Storm
Mitigation Plan (Part II, 3, b, 3 /4/.))

- (f) Policy Choices:

. improve capacity of route: not realistic

- . limit development: up to the Town of Washington Park and County. This is already an issue requiring attention.
- . increase evacuation notice time: a must.

(4) NC 17 and NC 33 in and through Washington, North Shore of Pamlico River.

- (a) Area below flood level: See Exhibit E.
- (b) Surge Inundation Points: Primarily the Pamlico River Bridge (see Exhibits P & S).
- (c) Extent of Impediment to Evacuation:

This area is heavily populated and there is much business development. If flooded, evacuees would have to take 15th Street to NC 17 and turn north.

(d) Reliance by Other Communities:

Very heavy, since Highway 92 and 264 dump into Washington.

Routes around the city should be taken to avoid overloading what will already be a severe evacuation problem in many sections of the flood area (lower half of the city).

- (e) Estimated Evacuation Time: (See Storm Mitigation Plan, (Part II, 3, b, /4/))

(f) Policy Choices:

Since routes have adequate capacity, and level of development is prescribed by the City of Washington, reliance upon early warning and early mobilization of rescue and evacuation efforts is required.

(5) Hwy. 17 South from Washington to Chocowinity

- (a) Area below flood level: See Exhibit E.
- (b) Surge Inundation Points: See Exhibits P and S.
- (c) Extent of Impediment to Evacuation:

Nearly the entire area from the Pamlico River Bridge to the town limits of Chocowinity is threatened by surge inundation. Many businesses are located there.

(d) Reliance by Other Communities:

Heavy, since all of the development on SR 1166 from Hwy. 17 to Oak Point has no other evacuation route.

(e) Estimated Evacuation Time: (See Storm Mitigation Plan, Part II, 3, b, 3 /4/.)

(f) Policy choices:

Efforts could be made, through policies developed in the Storm Mitigation Plan to limit or better allocate development on SR 1166. The remainder of the solution rests with early warning and willing evacuation.

(6) Hwy. 33 South from the Pamlico County Line to Hwy. 17

(a) Area below flood level: See Exhibit E.

(b) Surge Inundation Points: See Exhibits P and S.

(c) Extent of Impediment to Evacuation:

If evacuation starts early enough, there is no problem. The route has adequate capacity. However, if critical points L and K are flooded, there is no way out.

(d) Reliance by Other Communities:

Very heavy. The Lowlands and Hoboken communities of Pamlico County must evacuate along this route. This route serves one of the most erodible areas and most industrial areas in the County.

(e) Estimated Evacuation Time. (See Storm Mitigation Plan, Part II, 3, b, 3 /4/.)

(f) Policy Choices:

Since routes have adequate capacity, evacuation depends on warning time and willing evacuation.

c. Impediments Caused by Conflicting Information.

Beyond the physical terrain and facilities (routes), an impediment will always exist because people will choose who they want to listen to in the event of a storm. There is no way to ensure that the information is accurate. Emphasis should be placed on recognition of official vs. unofficial sources and actions taken to get the correct word into informal communication networks at the neighborhood level.

d. Impediments caused by Conflicting Evacuation Plans.

Currently, there exists a situation in Beaufort County of conflicting plans. Ideally, each town should have both a control group of elected officials and a support group comprising chiefs of services. Each town should appoint a liason officer who would go to the County's Emergency Operation Center when the EOC is activated to any degree. This liason should be a member of the town council and a respected community leader. He/she is the key link between the overall operation of the EOC (County Headquarters) and the smooth evacuation of the townspeople. Through this liason, the town can be kept informed with the latest information and the EOC can have an advocate from the Town on hand.

e. Impediments Caused by Attitudes.

There is a strong resistance among us to leave our valued property even in the threat of diaster. The example is given of a boat owner who threatens his life in an oncoming storm to guard his boat. While this phenomenon is almost impossible to rectify, an appeal to the higher values of life and adequate evacuation should be instilled through early education, as well as ways to secure property (or evacuate it) through ready and prompt response to early hurricane warning. Cooperation and thoughtful, timely action is the key.

D. Coordination with State and Federal Agencies.

1. Process

Throughout the preparation of this storm hazard mitigation, post disaster reconstruction and evacuation plan, the Office of Coastal Management, the Consultant (Planning and Design Associates, P.A.), and the County (Office of the Emergency Management Coordinator) have been contacting state and federal agencies for data, opinions on adequacy of local provisions, direction in policy development, regulations, and suggested points to be covered. Efforts to coordinate plans with practical were undertaken.

As mentioned at several points in this document, one of the keys to this coordination process came when Daden Wolfe brought Col. David W. Spivy to the project. Colonel Spivey's 22 years of experience as Area A Coordinator for the Division of Emergency Management have proven invaluable in terms of content and coordination.

2. Contact List.

The following contacts were made during the preparation of this document.

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